THE IMPACT OF TRAIT AND STATE ANGER ON EMOTIONAL
EATING FOLLOWING LABORATORY BASED MOOD INDUCTION

A dissertation presented

by

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Abstract

A laboratory based mood induction study was conducted on 61 non-clinical participants at the University of Massachusetts Medical School with secondary analysis of data to assess the impact of trait and state anger on emotional eating behavior based on post-mood induction caloric consumption. Results of linear regression, ANOVA and general linear model (GLM) analyses revealed a significant correlation of trait anger (as assessed by STAS score at participant screening) with post-induction caloric intake ($p = .0008$), after removal of data point outliers. State anger, as assessed by difference in pre- and post- induction POMS score, was not significantly correlated with caloric intake ($p = .12$). There was no evidence of a significant interaction effect between trait and state anger ($p = .13$). Gender was associated with increased caloric intake in male participants ($p < .0001$); however, this was apparent following both anger and neutral mood inductions. The induction procedure (anger versus neutral mood induction) and order of inductions were controlled for and were not significantly related to caloric intake. The findings allowed for development of an overall regression equation based on trait anger, state anger, and gender which achieved an $R^2$ of .32 ($p < .0001$), and suggested that for each one point increase in trait anger (by STAS score) there was a corresponding increase of 15 calories consumed. The importance of trait anger as a contributing factor in emotional eating deserves further study in larger samples and more natural settings, in particular to evaluate its potential contribution to pathologic eating behaviors and resultant disordered eating and obesity.
CHAPTER ONE: INTRODUCTION

Emotional eating describes a phenomenon whereby eating occurs in response to stress or to negative moods such as anger, depression and anxiety (Arnow, Kenardy, & Argas, 1998; Greeno & Wing, 2004; Solomon, 2001). There is evidence that both personality traits and transitory emotional states may predispose individuals to emotional eating (Macht, Roth & Ellgring, 2002). Eating in response to emotion may ultimately lead to obesity, eating disorders and other serious morbidity (Hays & Roberts, 2008). Obesity has become an epidemic in the United States, with over two thirds of Americans considered overweight, and one third considered obese (Centers for Disease Control, 2010).

Anger is an emotion that may be an important factor predisposing individuals to emotional eating (Narita et al., 2007). The propensity to become angry is an underlying personality trait, characterized by a tendency to experience frequent and intense episodes of this emotion (Spielberger, 1988). The interaction of both this underlying propensity and transitory anger states may play an important complementary role in triggering emotional eating. If underlying personality traits, emotional states, and demographic factors that predispose individuals to emotional eating can be identified, then early clinical surveillance, intervention and prevention may be possible. The present study will evaluate the influence of baseline trait anger, and induced state anger, on emotional eating following laboratory-based mood induction. It is anticipated that these findings may help identify psychological
characteristics and situations that make individuals more vulnerable to emotional eating.

The background literature on the etiology and public health significance of emotional eating and associated psychological and physical conditions will be discussed to provide a rationale for the current investigation. The focus will be on the relationships among trait anger (the propensity to experience anger episodes), state anger (transitory emotional states of anger) and emotional eating following induction of an anger state. The discussion will also include a review of the methodological limitations and unanswered questions in the extant literature.

**Rationale and Significance of the Problem**

A link between emotion and eating behaviors, such as overeating or binge eating, has been documented (Chua, Touyz, & Hill, 2004; Engelberg, Steiger, Gauvin, & Wonderlich, 2007; Greeno & Wing, 1994; Masheb & Grilo, 2006; Nguyen-Michel, Unger, & Spruijt-Metz, 2007; Penas-Iledo, de Dios, & Waller, 2004; Pinaquy, Chabrol, Simon, Louvet, & Barbe, 2003; Wallis & Hetherington, 2009). Researchers who have examined the idea that emotion can lead to overeating behaviors and potentially to being overweight or to obesity have found a stronger link between negative than positive emotions and eating (Edman, Yates, Aruguete, & De Bord, 2005; Goossens, Braet, & Decaluwe, 2007; Nguyen-Rodriguez, Chou, Unger, & Spruijt-Metz, 2009; Strien, Engels, Leeuwe, & Snoek, 2005). Hypotheses regarding the role of negative affect as a moderator of emotional eating range from temporally-related functions of eating to reduce or lessen states of emotional distress
to hypotheses which suggest that emotional eating may function to block intolerable emotional experiences. Chronic patterns of emotional eating may eventually trigger binge eating behaviors as well as disinhibited patterns of food consumption, as observed in some types of eating disorders (Masheb & Grilo, 2006). The phenomenon of emotional eating and its role as a potential precursor to more serious eating disorders or obesity has also been described (Streigel-Moore & Franko, 2003).

Research in the area of negative affect and emotional eating has mainly considered negative affect as a single homogeneous construct. However, negative affect is more comprehensively conceptualized as a variety of distinct mood states that includes anger, depression, and anxiety. Although there is literature supporting the notion of a link between the general concept of negative affect and emotional eating (Arnow, Kenardy, & Agras, 1995; Burton, Stice, Bearman, & Rohde, 2007; Costanzo, Reichman, Friedman, & Musante, 2001; Greeno & Wing, 1994; Solomon, 2001; Waters, Hill, & Waller, 2001), few observers have focused on specific negative affects, such as anger, depression or anxiety, and the particular functions these distinct emotions may play in putting individuals at risk for emotional eating. It is plausible that not all negative affective states result in similar eating behaviors. Studying specific mood states and the resulting impact on eating may lead to a more specific understanding of eating behavior, and ultimately facilitate development of more targeted and precise clinical interventions.

Research that has been conducted on specific negative affects and eating behavior has found that there are different responses to varied negative mood states
(Macht, 1999). For example, there is evidence suggesting that when individuals experience a state of physiological arousal and activation, such as during states of anger and resultant heightened hostility, food consumption may increase (Miotto et al., 2008). Conversely, other investigators have described that during periods of sadness individuals tend to eat less as a result of appetite suppression due to physiological slowing (Devlin, Goldfein, & Dobrow, 2003; Sysko & Hildebrandt, 2009; Wilfley, Bishop, Wilson, & Agras, 2007). In these two cases, differing negative affects have a significant, albeit opposite, effect on eating behavior. Hence, the general category of negative affect is made up of heterogeneous emotions, which need to be separately studied to better understand their specific impact on eating behavior. Prior studies which focused on the general topic of negative affect may have lacked the precision to describe and consider the potentially confounding impact of combining all negative emotions in the single category of negative affect.

The topic is further complicated by considering the differences between state and trait emotions. State emotions are transient, defined episodes of emotion, while traits are more consistent and enduring underlying personality characteristics and tendencies. Distinguishing these situational responses from more fundamental characteristic tendencies is another important consideration in assessing the role of affect on eating behavior. Research into emotional eating should consider both intrinsic personality traits as well as transient states that contribute to manifested behaviors. Few prior studies have considered this level of detail in their assessment.
To gain a fuller understanding of both trait and state emotions, careful empirical research is required.

**Limitations of Literature in this Area**

Evaluations of emotional eating have suggested that negative affect is correlated with this behavior (Geliebter & Aversa, 2003). However, less attention has been focused on the specific negative affect of anger and its role in emotional eating. There are a few studies that focus specifically on anger, such as its association with health conditions like cardiovascular disease and hypertension (Zaitsoff, Geller, & Srikameswaran, 2002); however, the relationship of these conditions to emotional eating behavior has not been clearly elucidated. State anger regulation or expression among chronic low back pain patients has been studied by anger induction, as well as the potential moderating effects of level of trait anger (Burns, 2008). However, despite these studies, in general the literature on negative affect fails to focus on anger, or its trait and state features, as a distinct type of negative affect.

In general, the literature that does consider anger suffers from another limitation. Many studies of anger have focused on measurement of hostility, which is the behavioral or physiological response to the emotion of anger (Deffenbacher, et al., 1996). It is unclear whether the descriptions of hostility in prior studies have a strong correlation with trait anger, which is better defined by its cognitive and perceptual distortions and tendencies that are enduring and not situational.
In terms of demographic variables, emotional eating behavior may differ significantly based on gender, body mass index, education level, income, ethnic group, marital status, size of household, and age (Larsen, Van Strien, Eisinga, & Engels, 2007). However, while there is some literature suggesting differences between men and women regarding emotional eating, there is very little in the literature that examines other demographic factors as they relate to emotional eating and anger.

Regarding gender, prior studies have suggested that it may play an important role in emotional eating behavior (Piquero & Fox, 2010), however, these studies were not experimental in design and did not focus on the effect of trait compared to state anger. For example, Penas-Lledo, Fernandez, and Waller (2004) demonstrated significant differences in the way in which men and women behave in response to anger. Based on self-report measures of non-clinical participants, women with high levels of trait anger and were more likely to engage in binge eating. Men were more likely to engage in other impulsive behaviors and self harm. Zellner (2006) studied non-clinical participants based on a self-report questionnaire and found that women had increased food consumption in response to anger, compared to men who tended to eat less. However, neither of these studies employed an experimental manipulation of mood, or a control group. Furthermore, they did not compare trait and state anger. Macht, Roth and Ellgring (2002) found that men reported lower levels of hunger in response to negative mood based on a mood induction study that employed short film clips to induce anger, fear, sadness and joy. However, a
comparison to matched female participants was lacking. A well controlled comparison of male and female participants evaluating the role of trait and state anger is required to more fully understand the impact of gender on emotional eating.

**Statement of Problem**

Maladaptive eating behaviors such as emotional eating may lead to serious health consequences, including cardiovascular disease, obesity, bulimia nervosa, and binge eating disorder (Masheb & Grilo, 2006). Among several types of negative affects, anger occurs commonly but has not often been comprehensively studied in a systematic or experimental way regarding its impact on emotional eating. Furthermore, prior work has failed to differentiate between state and trait anger, the interaction of these features, and the potential significance of particular demographic and participant characteristics such as gender and BMI category (lean versus obese). Many prior studies relied solely upon the outward expression of hostility as a marker of anger, rather than also examining underlying trait anger. Attaining an understanding of the significance of trait and state anger, and any interaction between them, as well as other demographic variables that may predict emotional eating requires empiric evaluation. Such an understanding may facilitate more specific and relevant opportunities for prevention, early intervention and therapy.

**Purpose of Research**

This secondary data analysis study seeks to determine the impact of both trait and state anger on emotional eating. In this study, level of trait anger is evaluated prior to exposure to anger stimuli that induce anger states, followed by measurement
of immediate caloric intake. The objective is to determine if there is a meaningful correlation between trait or state anger and emotional eating, as well as the potential for a complementary interaction between both trait and state anger and emotional eating. Demographic and other participant characteristics potentially correlated with emotional eating, such as gender and BMI, will also be assessed. A goal of the analysis is to use the data to derive a set of relationships among predictor variables (state anger, trait anger, demographic variables) that will allow for definition of tendencies, situations and traits that may predict emotional eating.

**Major Research Questions**

1. What is the relationship of the independent variable, trait anger, to the dependent variable of eating behavior, as assessed by caloric intake following anger mood induction?

   Hypothesis 1: Trait anger will be significantly correlated with post-mood induction caloric intake, such that higher trait anger will be associated with higher levels of post-induction caloric intake.

2. What is the relationship of the independent variable, magnitude of state anger, to the dependent variable of eating behavior, as assessed by caloric intake following anger mood induction?

   Hypothesis 2: Magnitude of state anger will be significantly correlated with post-mood induction caloric intake, such that higher state anger will be associated with higher levels of post-induction caloric intake.
3. Does an interaction effect occur between the independent variables, trait anger and magnitude of state anger, on the dependent variable of eating behavior, as assessed by caloric intake following mood induction?

Hypothesis 3: Trait anger and state anger will combine such that participants with higher levels of both trait anger and state anger will evidence higher levels of post-induction caloric consumption than would be expected due to either trait or state anger level alone.

4. What is the relationship between demographic variables (gender, BMI category, marital status, income, ethnicity, size of household and education level), and the dependent variable of post-induction caloric consumption?

Hypothesis 4: Participant gender will account for some of the variance observed in post-induction caloric intake. However, BMI category, marital status, income, ethnicity, size of household and education level will not be significantly related to the variance in post-induction caloric consumption.

**Potential Benefits of this Research**

Identification of significant relationships between trait and state anger and emotional eating may shed light on important risk factors for more serious eating disturbances, psychiatric disorders, and resultant obesity. Furthermore, defining subgroups at risk and the potential interaction of both trait and state anger could provide for better understanding of the underlying behavioral causes of emotional eating. This information may also promote more targeted observation, prevention, and therapeutic interventions.
CHAPTER TWO: LITERATURE REVIEW

Overview of Literature

This study will evaluate the effects of trait and state anger on emotional eating following an experimental anger mood induction. This literature review will initially focus on emotional eating and theories that attempt to explain the psychological underpinnings and correlates of this behavior, including how these theories relate to eating disorders, such as binge eating disorder (BED) and bulimia nervosa. Literature examining the relationship between mood and eating will be described, followed by a more narrowly focused discussion of the role of negative affect and eating behaviors. The impact of gender on emotional eating behavior will also be briefly reviewed. Following a discussion of related theories, the chapter will then turn to the construct of anger, its definition and a description of both state and trait anger. The role of anger and its impact on eating will be presented. The focus will then shift to the role that anger plays in health risk behaviors. The chapter will conclude with an examination of the link between emotional eating and obesity, overweight, diagnosable eating disorders and chronic medical conditions such as hypertension and diabetes. A description of mood induction methodology and the various types of induction procedures will follow, including a rationale for using this paradigm in the current study.
Review of the Literature

The epidemic of obesity around the world, and particularly in developed
countries, is a growing source of concern internationally (WHO, 2010). Estimates
suggest that more than one billion people worldwide are overweight, and by 2015 the
number is expected to reach 1.5 billion (WHO, 2010). In the United States, over two
thirds of people are overweight, and one third are obese (Centers for Disease
Control, 2011). A rise in diagnosed eating disorders has been described as a
contributing factor to this growing epidemic of obesity (WHO, 2010). As a result,
the phenomenon of emotional eating has received increased empirical attention as a
potential contributing factor. Emotional eating has been described as “eating in
response to negative mood such as depression, anger and anxiety” (Arnow, Kenardy,
overeat in response to negative emotions such as anxiety or irritability.” More
serious disorders such as bulimia and binge eating disorder have also been described
as being triggered by strong emotional experiences (Brewerton, Dansky, Kilpatrick,
& O’Neil, 2000; Dingemans, Martijn, van Furth, & Jansen, 2009; Fischer et al.,
2007; Pinaquy et al., 2003).

Emotional eaters turn to food in moments of strong emotion; however, these
eating episodes are not necessarily characterized by other features of clinically
diagnosable eating disorders such as bulimia. Bulimia is diagnosed in individuals
who eat very large quantities of food in a short duration of time. In addition, these
individuals also have a subjective sense of loss of control and may engage in
compensatory behaviors, such as excessive exercise and purging [Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV); APA, 2000]. Emotional eating may be a precursor to the development of disordered eating, including the development of bulimia or BED (Goossens et al., 2009).

Cross-sectional and prospective associations between emotional eating and BED have been reported (Ricca et al., 2009; Stice, Presnell, & Spangler, 2002). BED is not recognized as a formal diagnosis in the DSM-IV; however, it is under consideration for inclusion in DSM-V as a diagnosis different from other eating disorders (Grilo, White, & Masheb, 2009; Ramacciotti et al., 2000; Wonderlich et al., 2009). BED is characterized by uncontrolled episodes of binge eating, often ending only when there is an uncomfortable sense of fullness. Additionally, BED is marked by a rapid consumption of food in a short duration of time as well as a sense of shame and guilt following the behavior. Binge episodes occur at least twice weekly and continue over a period of six months or longer. Unlike bulimia, BED does not include a pattern of engagement in compensatory behaviors such as food restriction, excessive exercise or purging following binge eating. Emotional eating has been described as a core feature in the development of binge eating behaviors, and thus may be a predictor or precursor of BED (Moon & Berenbaum, 2009).

**Theories of Affect and Eating**

Research supports the notion that emotional activation can cause changes in eating behavior (Spoor, Bekker, Van Strien, & Van Heck, 2007). The relationship between emotion and eating behaviors has been studied from a variety of theoretical
perspectives. Early work done by Kaplan and Kaplan (1957) conceptualized a psychosomatic understanding of overeating and obesity, suggesting that pleasure experienced during eating can at least temporarily reduce states of anxiety or tension. More specifically, a learned association between eating and stress reduction is established, whereby eating becomes reinforcing as a behavioral response to distress. Such associations lead to difficulty differentiating feelings of physical hunger from those of emotional discomfort. Bruch (1973) offered a psychoanalytic understanding of obesity describing the influence of early feeding patterns characterized by infants being given food in response to distress. This theory suggests that as a result of chronic maternal misinterpretation of cues, confusion results between internal awareness of physiological hunger cues and emotional activation. Eating becomes a response to uncomfortable emotion rather than to physiological hunger, which can lead to harmful long term effects, including obesity. These early theories were based on the premise that overeating results from an impaired ability to recognize and respond to physiological cues of hunger and satiety. Instead, according to these theories, eating occurs in response to dysphoric affect or negative emotion.

More contemporary research on mood and emotional eating has found evidence of changes in eating behavior in response to both positive and negative emotional states. For example, Macht (1999) studied specific emotions and their effects on eating behaviors. This study analyzed self-report data in which participants were asked to complete questionnaires aimed at examining perceptions, cognitions, and feelings related to eating and food. Four emotions were evaluated:
anger, sadness, joy and fear. Beside each of the four emotions were related adjectives (e.g., “annoyed” next to the emotion of “anger”) to trigger imagining the intended emotion. The questions then focused on behavioral response choices to be paired with the specific emotion. For example, “When I experience a feeling of anger (or feel annoyed), after having skipped meals, I…” Choices for these answers included statements such as “I eat faster,” “I eat less,” and “I think more of food.” Comparisons among the four emotions revealed distinctly different impacts of the emotions on eating behaviors. For example, anger and joy were associated with higher levels of perceived hunger than were fear and sadness. Joy was associated with higher levels of hedonic eating than were the other emotions. Macht also noted gender differences in this study, with women reporting more impulsive eating behaviors during anger and sadness than men. Findings from this study suggested that anger may play a more influential role in emotional eating than other negative moods such as sadness and fear. This study highlights an important observation that not all negative emotional states necessarily trigger emotional eating, and specific affects need to be considered individually in the study of emotional eating.

Emotional eating may provide relief in alleviating particular affects but in different ways. For example, eating in response to feelings of depression might provide relief by triggering a positive mood state, while in the case of anger eating may serve to induce a state of calm (Eddy et al., 2007; Goossens, Braet, & Decaluwe, 2007).
Three specific theories have emerged related to affect and eating behavior: affect regulation theory, restraint theory and escape theory. They each provide different formulations of the relationship between affective experiences and eating behavior.

**Affect regulation theory.** More recent theoretical conceptualizations of the relationship between mood and eating behaviors have focused on the affect regulation model of emotional eating (Arnow, Kenardy, & Agras, 1995; Telch & Agras, 1996). Specifically, the affect regulation theory suggests that eating in response to emotion occurs as an attempt to alleviate uncomfortable emotional experiences in some individuals (Goossens, Braet, & van Vlierberge, 2009; Grilo & Shiffman, 1994). This theory builds upon early theories of hunger and obesity that had suggested a learned association between eating and reduction of uncomfortable or negative affect (Spoor, Bekker, van Strien, & van Heck, 2007). Emotional eating represents a phenomenon different from the expected biological response to strong emotion, which would be food restriction and decrease in appetite based on increased levels of arousal (Heatherton, Herman, & Polivy, 1991; Lindeman & Stark, 2001; Spoor, 2007). Thus, emotional eating represents an unexpected response to stress that may be contrary to expected physiologic patterns, underscoring the need for its continued study (Torres & Nowson, 2007).

A variety of studies has examined the relationship between mood and eating behaviors and supports the affect regulation theory (Arnow, Kenardy, & Agras, 1995; Goosens, 2009; Grilo & Shiffman, 1994; Telch & Agras, 1996). In a review
of fifteen studies of emotional eating, Ganley and colleagues found that 84% to 100% of obese individuals engaged in overeating episodes as a response to a variety of affective states, which included anger, anxiety, and depression (Ganley, 1989). Oliver and colleagues (2000) evaluated the effects of stress on eating in a study in which those in the experimental group were instructed to prepare a speech that they were told would be videotaped, before eating a meal. Control group participants were instructed to relax and listen to an affectively neutral recorded passage, prior to eating a meal. Participants were divided into high and low emotional eating groups as measured by subscales of the Dutch Eating Disorders Questionnaire (DEDQ; Van Strien, 1986). Results of the study revealed that high emotional eaters were found to eat almost twice the amount of sweet, fatty foods than did low emotional eaters; however, for participants who were not under stress manipulation (both high and low emotional eaters) there was no difference in intake of sweet, fatty foods. Interestingly, while there were no main effects related to gender, the study did reveal that appetite for sweet foods was increased by stress in men, but not in women. However, in unstressed control participants, women chose to eat sweet foods more than men. Hence both emotional eating tendencies and gender may have an effect on food choice.

Although there is evidence of the influence of both positive and negative emotions on eating behaviors, the majority of research in this area has focused on negative affect, and specifically, anger, anxiety, and depression. Research on emotional eating and affect regulation theory has found that emotional eating is more
commonly associated with these negative emotional experiences than positive affective states (Wolff et al., 2000). Research has identified several negative emotions that are related to emotional eating, including anxiety, loneliness, boredom, anger, and depression, particularly among obese individuals. Mehrabian and Raccioni (1986) found that participants reported reduced food consumption during states of high arousal, such as anger. This study also found a tendency for the consumption of unhealthy foods during negative affective states, while healthier foods were eaten during positive emotional states.

In summary, affect regulation theory suggests that emotional eating represents a learned behavioral response that functions to modulate mood. Furthermore, emotional eating behaviors tend to be more likely triggered by negative mood states such as anger, depression and anxiety.

**Restraint theory.** Restraint theory, as described by Herman and Polivy (1980), posits that negative affective states result in overeating in individuals who engage in chronic restrictive eating or dieting patterns. Specifically, individuals who chronically restrain their eating by self-imposing rigid and punitive eating rules may be at increased risk for overeating in response to negative affect (Herman & Polivy, 1980). A pattern of chronic attempts to inhibit eating becomes challenged by overwhelming urges to eat. Inevitably, under the strain of emotional distress, disinhibited eating episodes may ensue. People who engage in this pattern are referred to as “restrained eaters.” In a study of restraint and eating behaviors, Ruderman and colleagues (1985) observed that restrained eaters ate more after an
induced negative affective state than non-restrained eaters who were exposed to the same conditions. Such a determination suggests the link between emotion and eating behaviors in those who restrict food.

Restraint theory posits that repeated attempts to ignore physiological hunger lead to preoccupation with food, and stress results in chaotic overeating behaviors. In support of this notion that restrained eaters may be vulnerable to disinhibited eating behaviors when faced with uncomfortable affect are studies using a pre-load manipulation. In such studies, participants are instructed to eat large quantities of food (the “pre-load”) before participating in a taste test. Results from these studies show that restrained eaters consume more during the taste test than do non-restrained eaters, which may be a result of negative feelings triggered by their disinhibited consumption of food during the pre-load condition (Polivy, 1994; Williams, 2002). Some authors have suggested “a counter-regulatory eating effect” to explain the observation that restrained eaters ate more after drinking one or two milk shake pre-loads than they did after not drinking a pre-load; hence, the pre-load may serve as a disinhibitor of their restraint behavior (Herman & Mack, 1975).

Restraint theory also suggests that chronic restriction of food leads to increased sensitivity to external cues rather than physiological hunger signals. Paradoxically, food becomes more appealing and more attractive as the individual feels increasingly deprived, thereby increasing vulnerability to uncontrolled eating episodes in the face of uncomfortable emotion (Heatherton et al., 1991). Ongoing attempts to ignore or rigidly control physiological hunger cues can result in an
impaired ability to recognize these markers over time, which can make the restrained
eater vulnerable to disinhibited eating when faced with emotional distress (Eldredge,
1993; Greeno, & Wing, 1994; Lowe, 2003; Safer, Telch, & Agras, 2001; Stice,
Akutugawa, Gaggar, & Agras, 2000; Wallis & Hetherington, 2004).

Research rooted in restraint theory has also investigated different types of
chronic dieters, who may be sorted into distinct behavioral categories. For example,
Lindeman and Stark (2001) performed cluster analyses of self-report measures, i.e.,
DEBQ, Eating Attitudes Test (EAT; Garner & Garfinkel, 1979) and the Eating
Disorder Inventory (EDI; Garner, 1991), to determine the participants’ propensity for
emotional eating behaviors. This analysis allowed them to divide a group of female
college participants into four sub-type categories based on results of hierarchical
cluster analyses on three variables (restrained eating, emotional eating, and bulimic
tendencies). They describe the four subtypes in the statistical categorization as non-
dieters (who endorse restrained eating significantly less than normal dieters), normal
dieters (who report restrained eating, but not emotional eating or bulimic behaviors),
emotional dieters (who had higher rates of eating disorder pathology and lower self-
esteeem than the normal dieters who did not eat in response to emotion) and bulimic
dieters (who scored higher on interoceptive awareness, body dissatisfaction, and
bulimia, compared to both normal dieters and emotional dieters). The bulimic dieter
group scored highest in emotional eating and bulimic tendencies. Those in the non-
dieter group scored low on all self-report measures. The normal dieter group
reported restrained eating but not emotional eating or bulimic behaviors. Results
revealed that the three dieter groups, including the emotional dieters, were more likely to engage in emotional eating than those in the non-dieter group. Furthermore, those who engaged in binge/purge eating behaviors (bulimic dieters) reported the greatest frequency of eating in response to emotion. This research suggests significant variability in emotional eating behaviors among chronic dieters, and a relationship between emotional eating, restraint, and more disordered behavior.

**Escape theory.** Escape theory offers another conceptualization of the relationship between affect and overeating. This theory suggests that engaging in emotional eating functions to shift attention away from or escape from some form of aversive self-awareness (Heatherton & Baumeister, 1991; Spoor, 2007). In contrast to affect regulation theory, escape theory emphasizes that overeating occurs in response to stimuli that are perceived as threatening to sense of self. For example, perceived threat of personal failure may trigger an emotional eating response while threat of physical harm may not trigger such a response. In this model emotional overeating serves to distract the self from threatening cognitions, such as “I am a failure” (Wallis & Hetherington, 2004).

Individuals who eat in response to stress impose extremely high personal standards for achievement on themselves, which leaves them vulnerable to feeling inadequate (Bekker, van de Meerendonk, & Mollerus, 2004). These individuals, who chronically strive for excessively high standards, are prone to negative emotional states because of their self-imposed, unrealistic expectations. Recent research has supported this assertion. For example, individuals who self-impose
high standards and who also experience body dissatisfaction are more vulnerable to binge eating, particularly when they perceive themselves as powerless to create change (Bardone-Cone et al., 2007). According to escape theory, eating serves to minimize experiences of unpleasant self-awareness, because attention becomes narrowly focused on food and eating instead of unpleasant emotions. Thus, based on escape theory principles, eating serves to avoid aversive self-awareness.

Research supporting escape theory comes from laboratory-based investigations. For example, in a comparison study between bulimic and non-eating disordered women, Hallings-Pott presented participants with a computer-based task which included a series of subliminal words and messages that were considered either threatening to the self, (e.g., “loneliness”) or neutral, (e.g., “paint”) (Hallings-Pott, Waller, Watson, & Scragg, 2005). Dissociation was measured by the Dissociative Experience Scale (DES; Carlson & Putnam, 1993). Results indicated that bulimic participants dissociated during the threatening condition, while those without bulimia did not. These results suggest that stimuli experienced as threatening in some way to sense of self are avoided, as suggested in escape theory. While this study did not specifically assess eating behavior, it does lend support to the notion that eating disordered participants such as bulimics have a tendency to escape from ego threatening conditions.

Heatherton and colleagues (1991) divided participants into either a physical threat condition, in which they were told that they would receive an electrical shock, or into one of two possible ego-threatening conditions. The first of these ego-threat
groups was told that they would receive a shock, if they failed a task. The second ego-threat group was told that they would need to deliver a speech that would be videotaped. All three groups of participants then took part in an ice cream tasting portion of the study. Results showed that the participants in the ego threatening conditions (shock related to failure of a task or speech delivery) ate more than the participants in the physical threat condition. Results for the physical threat participants were attributed to the expected physiologic response to physical harm, mediated by the sympathetic nervous system. This “fight or flight” response with resulting decrease of appetite was first described by Cannon (1914). The findings in the ego threat groups provide suggestive evidence for the avoidance mechanism in escape theory, leading to increased eating. One interpretation is that participants who faced ego threatening conditions actually ate more ice cream, which may be an attempt to escape from negative cognitions that threaten sense of self, as described in escape theory. However, an alternate explanation for these findings relates back to affect regulation theory whereby participants may have connected eating to improvement of mood.

In another study of escape theory and emotional eating, Schwarze analyzed data from college women classified as either binge eaters (BE) or non-eating disordered (NED) (Schwarze, Oliver, & Handal, 2003). Self-awareness was measured by the private self-consciousness subscale of the Self Consciousness Scales (SCS; Fenigstein, 1975), the Rosenberg Self-Esteem Scale (RSE; Rosenberg, 1965), and the Beck Depression Inventory (BDI; Beck, 1961). Analyses of these
measures showed that the BE group had high levels of negative self-awareness as evidenced by higher scores on the self-consciousness scale as well as lower scores on self-esteem than those in the NED group. Negative self-awareness refers to a tendency to evaluate oneself in a critical way when self-imposed unrealistic personal standards are not met. Furthermore, binge eaters showed both higher levels of avoidant coping style as measured by the Coping Inventory for Stressful Situations (CISS; Endler & Parker, 1999) and higher levels of depression than the NED group. These findings, particularly the avoidant coping style of the binge eaters, may support the escape theory’s postulate of escape from negative self-awareness in emotional eaters. An alternate explanation of these findings would interpret them as consistent with affect regulation whereby binge eating behaviors function to modulate negative affect.

In summary, there are three main theoretical models describing the relationship between affect and eating that offer a conceptualization of emotional eating. Affect regulation, restraint theory, and escape theory offer varying ways in which to consider and formulate the notion of eating in response to negative emotion.

**Definitions**

**Anger**

Anger has been conceptualized as a multidimensional construct composed of physiological states, cognitions and behavioral responses to situations. Kassinove (1995, p. 11) describes anger as a “negative feeling state associated with specific
cognitions and perceptual distortions and deficiencies, subjective labeling, physiological changes and action tendencies to engage in socially constructed and reinforced organized behavioral scripts.” Anger is a common emotion that is experienced as often as several times daily to several times weekly and has both physical and emotional manifestations (Averill, 1983). It has been described as a “negative phenomenological experience that exists on a continuum in which the frequency, intensity and duration of the experience, along with expressive (i.e., subjective, physiological, interpretive, and behavioral) characteristics often leads to significant impairment” (Kassinove, 1995, p. 7). Anger can vary in both intensity of the emotion and in duration. Physiologically, anger triggers increases in heart rate and blood pressure, as well as a host of sympathetic nervous system functions that increase awareness and arousal. Hostility and aggressiveness have been conceptualized as behavioral responses to the emotion of anger, thus representing a construct different from anger itself. Spielberger (1988) described hostility and aggression as physiological responses that can occur as a result of anger.

**Theories of anger.** Anger has been studied from many theoretical perspectives spanning from early evolutionary theories to more modern cognitive theories. Evolutionary theory as described by Darwin (1872) suggested that aggression and arousal lead to an ability to defend oneself in the face of threat or enemy attack. More recent theoretical perspectives of anger and aggression include drive theory, which suggests that frustration resulting from an inability to engage in goal-directed behaviors leads to a proclivity toward aggressive reaction (Bushman,
2002). This theory differs from others, such as the psychoanalytic model, in that it asserts that aggression is a reaction, rather than an instinct, and that there is a proportional relationship between levels of frustration and levels of related aggressive behavior.

**Anger: state versus trait.** Research into the construct of anger has divided anger into two categories, state anger and trait anger. State anger refers to temporary experiences of anger, while trait anger describes an underlying personality feature marked by a greater propensity toward the subjective experience of transitory anger (Kassinove, 1995). Individuals with high levels of trait anger tend to be more prone to frequent episodes of anger than those with lower levels of trait anger and may experience anger states with more intensity and for longer periods of time (Spielberger, 1988).

High levels of trait anger are also associated with a plethora of medical and psychological conditions, including unhealthy lifestyle behaviors such as over-eating and resultant obesity. For example, high trait anger has been linked to high cholesterol, cardiovascular disease, and sleep disturbances (Eng et al., 2003). Interestingly, all of these disorders are also related to overweight and obesity, though the potential association of anger and emotional eating is less clear. Suppressed anger, in particular, has been associated with higher levels of perceived pain as well as a lower threshold for the tolerance of pain (Quartana, Yoon, & Burns, 2007). Furthermore, anger suppression has been associated with other unhealthy behaviors
including poor diet, infrequent exercise, alcohol consumption and smoking (Anton & Miller, 2005).

**Anger expression.** Behavioral response to anger can vary from suppression of this affect to outward expression of anger. Individuals with high levels of trait anger may suppress anger by directing it inward (Spielberger, 1995). Anger suppression involves a physiological reaction to anger but with no outward expression of this affect (Boddeker & Stemmler, 2000). Anger suppression style has been associated with many medical conditions such as high blood pressure, impaired immune function, and cancer (Vandervoort, Ragland, & Syme, 1996; Zaitsoff, 2002). Anger suppression describes a style of coping that is characterized by a tendency to avoid experiences which involve any type of confrontation. Individuals with a suppressive style of response to anger, also referred to as “anger-in,” have a tendency to subvert their own needs in place of satisfying or caring for others. Individuals who respond with “anger-in” features may also be at risk for depression (Picardi, 2004). Research has also found that anger suppression, in combination with subverting internal psychological needs, is associated with psychological maladjustment (Sperberg & Stabb, 1998). Anger tends to get directed inward, rather than toward the external source of frustration. Suppression of angry feelings may function as a way to escape from uncomfortable negative self-awareness, such as described by Heatherton’s theory of escape (Cooper et al., 1992; Heatherton & Baumeister, 1991). In this formulation, individuals are escaping from the tendency to experience anger by suppressing their innate emotions.
Styles of anger expression have been the focus of much research on health. Igna and colleagues (2009) studied hypertension and anger expression styles, including suppressed anger (“anger-in”), expressed anger (“anger-out”) and control of outward expression of anger (“anger-control”) with participants categorized by the State Anger Expression Inventory (STAXI; Spielberger, 1996). The “anger-in” style was associated with elevated blood pressure in participants who used alcohol and had poor diet as measured by the participants’ self-report lifestyle inventory. The “anger-control” style did have a positive direct relationship to blood pressure. The “anger-out” style had a statistically significant relationship with decreased blood pressure.

**Anger and emotional eating.** Emotional eating has been studied in relation to anger (Macht, 2002; van Strien, 2007). However, the relationship between anger and emotional eating has been written about primarily from a theoretical perspective, with only limited empirical research, mostly in populations with disordered eating. Despite the limited literature, there are significant potential consequences of anger tendencies and expression, given the association of anger with serious health conditions, such as cardiovascular disease and high blood pressure, as well as health risk behaviors, such as smoking and alcohol consumption (Blumenthal & Kaplan, 1999). Work by Fava et al. (1995) evaluating self-report measures based on the Anger Attacks Questionnaire (AAQ; Fava et al., 1991) and Beck Depression Inventory (BDI; Beck, 1961) of clinical participants and non-clinical controls, found that as many as 31% of individuals with eating disorders also suffered from anger.
attacks, characterized by clinical symptoms such as chest pain, and hostile behaviors, such as physical outbursts and irritability.

Comparative studies of individuals with and without eating disorders further help clarify the relationship between anger expression and eating behaviors. For example, Waller compared data from self-report questionnaires completed by women with diagnosed eating disorders and a control group of females without eating disorders. The study evaluated levels of anger as well as unhealthy cognitions. Anger was evaluated with the State Trait Anger Expression Inventory (STAXI; Spielberger, 1996), a self-report measure which examines various aspects of anger that contribute to trait and state anger. This scale also evaluates styles of anger expression such as suppression of anger and outward expression of anger. Analyses of the questionnaires revealed that women with eating disorders had higher levels of state anger and anger suppression than those in the control group. Furthermore, the eating disordered women who reported engaging in bulimic behaviors, such as bingeing and purging, were particularly likely to suppress anger (Milligan & Waller, 2000; Waller et al., 2003). In contrast, other investigators have observed that participants with bulimia were found to outwardly express anger toward others, while participants with anorexia nervosa (AN), or restrictive eating patterns, were found to suppress anger (Tiller, 1995). While these studies vary in the disorders associated with anger expression and suppression, they do reveal an overall association between anger and disordered eating.
Levels of trait anger are associated with different types of behavioral responses, including emotional eating (Macht, 2002). Research examining a link between anger and emotional eating has demonstrated that for some individuals underlying trait anger can be associated with maladaptive eating behaviors, such as binge eating and purging (Waller et al., 2003). Work by Schneider et al. (2010) employed trait (STAS) and state (POMS) measures of anger and anxiety as well as BMI to evaluate post-induction caloric intake in a laboratory based mood induction study of emotional eating. Obese and lean participants were divided into separate cohorts. Their results suggested no significant relationship between trait and state anger and post-induction caloric intake. BMI and anxiety were also not significantly correlated with caloric intake.

**Hostility and eating.** In addition to the literature on emotional eating and anger, studies have examined the related construct of hostility, defined as a behavioral response to the emotion of anger. Spielberger (1985) described hostility as a more comprehensive and broader concept than anger, because it encompasses features such as hatred and resentment, in addition to anger. There are a wide range of hostility scales. A meta analysis of hostility identified 63 different such scales (Miller et al., 1996). Heterogeneity in these scales tends to dilute the reliability of the findings across studies. One of the more prominent scales used to measure hostility is the Cook and Medley Hostility (Ho) scale. It is comprised of 50 true and false questions relating to cynicism, hostile attributions, hostile affect, aggressive responding, and social avoidance (Cook & Medley, 1954).
Studies have found that women with eating disorders have higher levels of hostility than those without eating disorders (Williams, Chamove, & Millar, 1990). Additionally, Williams and colleagues (1990) analyzed self report data from women with bulimia, anorexia and a control group and found a positive relationship between severity of eating disturbance and level of hostility. These data suggest some association between high levels of hostility and disordered patterns of eating. Compulsive eating patterns, such as binge eating and bulimic behaviors, and high levels of hostility, have been correlated by other investigators (Kagan & Squires, 1984). While these findings are interesting, and hostile behavior and cognitions may be a marker for trait anger, they do not necessarily represent a direct evaluation of the emotion of anger as defined in this study.

**Gender and Emotional Eating**

Gender differences may play an important role in the occurrence of emotional eating. Research has suggested that femininity, more than masculinity, is associated with emotional eating and eating disorders (Meyer, Blissett and & Oldfield, 2001). Meyer and colleagues (2005) analyzed self report data from college-aged women and men in order evaluate the impact of anger on eating behavior. Participants completed both the STAXI and the Bulimic Investigatory Test Edinburgh (BITE; Henderson & Freeman, 1987), a questionnaire that focuses on symptoms and severity of bulimia. This measure also includes items that address eating, weight, and shape concerns. Results suggested that males who experienced state anger were more likely to endorse bulimic attitudes, and employ bulimic behavior to diminish
their anger state. Women who suppressed anger were more likely to have bulimic attitudes, and engage in bingeing behaviors to avoid experiencing anger. These findings support the notion that men binge to reduce angry feelings, while women binge to avoid experiencing anger altogether.

Recent research also describes significant differences between men and women in the eating response to emotional stress (Zellner et al., 2006). Women tended to increase food consumption in response to anger, while men tended to eat less. Similarly, relative to women, men were found to experience lower levels of hunger in response to negative mood, while negative mood increases hunger in women (Macht, Roth, & Ellgring, 2002).

Penas-Lledo conducted a retrospective, self-report study of non-clinical participants that found women with higher levels of trait anger (as measured by the STAXI) were more likely to engage in binge eating, and were less likely to restrict food intake (Penas-Lledo, 2004). In contrast, men who experienced higher levels of anger “used more impulsive behaviors such as substance abuse and self harm.” Hence, anger in this study was associated with markedly different behaviors in men and women, but at least for women, anger was associated with dysfunctional eating behavior.

Regarding trait anger, both men and women who were high in trait anger were found to have higher body mass index (BMI) and were more likely to engage in binge eating than those lower in trait anger (Narita, 2007). Interestingly, the same study found that women high in trait anger were more likely to increase food
consumption during periods of emotional distress, such as anger episodes, than were men who were high in this trait. Since trait anger describes the tendency to experience anger episodes these findings are consistent with other studies that suggest increased emotional eating behavior in women relative to men during periods of emotional distress. While men may tend to eat more sweet, fatty foods in terms of food type preference under stress (Oliver, 2000), overall likelihood to increase food consumption in response to stress is greater among women (Narita, 2007).

Mood Induction

Mood induction refers to laboratory-based procedures during which affective states are induced through a variety of techniques. Mood induction procedures have been used effectively with a variety of mood states, and can reliably provide statistically significant changes in participants’ responses to behavioral and cognitive rating scales as a function of mood (Hernandez, van der Wall, & Spring, 2003).

There are several different types of mood induction procedures. In mood induction studies utilizing imagery, participants are instructed to recall situations in their lives that provoked certain feelings and then to try to re-experience these feelings (Richardson & Taylor, 1982). Participants are sometimes also instructed to write about the events, as well as associated thoughts and feelings. The Velten induction procedure (1968) is the most common mood induction and involves presenting participants with phrases that refer to self-evaluations such as “I am worthwhile” or phrases that refer to physical states such as “I am feeling lethargic”
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(Westermann, Spies, Stahl, & Hesse, 1996). Participants are instructed to try to feel these particular states. Mood induction can also be done with film or music, whereby participants listen to or view mood suggestive material and are instructed to experience the situation or mood and associated feelings (Torres, Van der Does, 2002). Hypnosis has been employed to induce mood where participants are given a form of a hypnotic induction (Natale & Hantas, 1982). Facial expression can be used to induce mood by instructing participants to flex certain facial muscles in order to create a frown, smile or neutral facial expression resulting in the desired mood (Schneider, Gur, Gur, & Muenz, 1994).

**Effectiveness of mood induction procedures.** Imagery, film and music inductions are found to be the most effective procedures for mood induction, with as many as 75% of participants achieving the targeted mood state (Westermann, 1996). Velten procedures tend to be less effective, with approximately 50% success (Westermann, 1996). To test the effectiveness of mood induction, manipulation checks, such as mood checklists, rating scales, and sometimes physiologic signs, such as heart rate or blood pressure, are measured. Scores obtained are compared to those obtained in neutral conditions and at baseline.
CHAPTER THREE: METHOD

Overview

A secondary data analysis study was performed using a data set originally obtained as part of the University of Massachusetts Medical School eating study entitled, “Eating and Negative Affect: The Influence of BMI and Gender” (Schneider et al., 2010). The original study examined differences in eating response between lean participants (BMI < 25) and overweight participants (BMI > 30) following induction of anger, anxiety, and neutral mood states. All participants underwent all three condition inductions. An imagery-based induction procedure was used for the original experiment. Emotional eating was measured by calories consumed in the 20 minute period following mood induction. While this study collected data on state and trait anger levels for all participants, no analysis of more specific aspects of state anger, such as the magnitude of the anger state induced and its relationship to trait anger and post-induction caloric intake was conducted by the original investigators. The original study also collected data following an anxiety mood induction which was not evaluated as part of this analysis, since the focus of the current study is on the complex aspects of anger.

In the current study, the questions analyzed were whether high levels of trait and state anger correlate with emotional eating when an anger mood state is induced. The study also evaluated the combined effect of magnitude of anger state induction and trait anger to examine an interaction effect between these two variables on post-induction caloric intake. A neutral mood induction was performed in order to
provide a control for the experimental induction procedure. The anger mood induction and neutral mood induction were performed in counterbalanced order to control for a carryover effect that might be based on sequence of inductions (i.e., anger induction influencing subsequent neutral induction or vice versa). The impact of demographic factors and participant characteristics such as gender, BMI category, ethnicity, marital status, income, size of household and educational level on emotional eating behavior were also assessed.

**Participants**

Participants in the study \( n = 61 \) were selected from a larger, diverse sample who were screened to determine study eligibility \( n = 138 \). Recruitment was facilitated by advertisements in local newspapers and on radio in the Massachusetts area, as well as by posted flyers in the ambulatory clinics of the University of Massachusetts Medical Center in Worcester, MA. Exclusion criteria for participation included a medically unstable condition (e.g., recent myocardial infarction, diabetes), smoking more than three cigarettes daily, use of nicotine patches, food allergies, current substance abuse or dependence, psychotic disorder, bipolar disorder, anorexia nervosa, bulimia nervosa, active suicidal ideation or behavior, restricted diet, and medications that affect mood or appetite. Female participants were also excluded if they reported a history of severe premenstrual dysphoria or were menopausal or peri-menopausal, pregnant, or lactating. Only participants with high BMI (above 30) and low BMI (below 25) were included in the study, in order to have a comparison of obese and lean participants. Hence, any
potential participant with BMI between 25 and 30 had a non-qualifying BMI and was excluded. Participants who were unable to read the mood questionnaires as well as those who were not inducible to negative moods during the screening session as assessed by the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971) were also excluded. Individuals who did not score at least four points higher on the POMS total score following induction of anger mood compared to the pre-induction administration of the POMS were considered to be non-inducible.

**Measures**

**Demographic Information Questionnaire**

Participants completed a brief demographic questionnaire that asked them to record their age, gender, BMI category (divided into lean and obese groups), ethnicity, income, education level, size of household and marital status. The participants’ health background was assessed for their level of caffeine consumption, level of nicotine use, and other medical information to ensure that the participants met the selection criteria.

**Independent Variables**

Trait anger was assessed using the trait measures of the State Trait Anger Scale (STAS; Spielberger, 1988). State anger measurement will be assessed by comparing the difference between pre and post-induction Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971) anger subscale measures.

**State Trait Anger Scale.** The STAS is a self-report questionnaire which consists of 40 items, 20 that target state anger and 20 that target trait anger. Only the
trait anger measures were analyzed in the current study. A four point Likert Scale is used for each item (“not at all” measured as 1 to “extremely” measured as 4). The STAS has established means and standard deviations that create a normal distribution in individuals who have completed a minimum of sixth grade education. Internal consistency of the STAS was evaluated for state items and trait items, with internal consistency alpha ratings of .94 and .79 respectively (Kroner & Reddon, 1992). Validity of this measure is supported by high correlation with the Eysenck Personality Questionnaire (Eysenck & Eysenck, 1979), which includes extraversion, neuroticism, psychoticism, and three hostility measures: the Buss-Durkee Hostility Inventory (BDHI; Buss & Durkee, 1957) and an MMPI hostility scale, the Hostility (Ho) Scale developed by Cook and Medley (1954). In particular, the BDHI (correlation of .66 to .73) and the Hostility (Ho) Scale (correlation of .43-.59) demonstrate moderate correlation with the STAS (Spielberger & Butcher, 1983).

**Profile of Mood States.** The POMS is a self-report paper and pencil measure consisting of 65 items evaluating six mood states, including anger, anxiety, depression, fatigue, confusion and vigor. A five-point Likert scale (“not at all” measured as 1 to “extremely” measured as 5) was used to evaluate both current mood and mood during the week before evaluation. Internal consistency ratings for the POMS range from 0.63 to 0.96, using Chronbach alpha (McNair, 1981; Belza, 1995; Evangelista et al., 2008). McNair, et al. (1971) describes the six mood factors that make up the POMS to be stable in a variety of different situations. The validity of the POMS for mood assessment is supported by strong relationships between
outcomes on this measure and other psychometric tests. For example, Watson and colleagues (1992) compare the Positive and Negative Affect Schedule (PANAS-X; Watson et al., 1992) and found, as expected, significant positive correlations between positive and negative mood states and corresponding POMS scales. Specifically the POMS Anger-Hostility Scale correlated with the PANAS-X hostility measure (correlation of .85) (Watson & Clark, 1994). The entire POMS six scales had a correlation of .8 with the Hopkins Symptom Distress Scale (Frank-Stromborg & Olsen, 2004).

**Hunger Ratings.** Hunger ratings for each of the participants were also collected, using a simple ten-point Likert Scale (“not hungry at all” measured as 0 to “extremely hungry” measured as 10).

**Dependent Variable**

The dependent measure was calories consumed following mood induction. Calorie counts were determined based on known caloric values per gram of food item from nutrition packaging information for the foods consumed, multiplied by the amount of each food item consumed post-induction, measured in grams. Amount of food consumed was determined by weighing food portions (in grams) before and after participant had mood induction and eating sessions.

**Procedure**

Individuals responded by phone to study participant solicitation advertisements placed in local newspapers and ambulatory clinics. Respondents were provided with an explanation of the study and were screened for inclusion.
Eligible respondents were then invited for a screening visit. An honorarium of $75 was provided for each participant. Informed consent was obtained at the screening visit, which occurred at the Department of Behavioral Medicine at the University of Massachusetts Medical School in Worcester, MA. All protocols were developed according to the human subject research guidelines of the University of Massachusetts Medical School, approved by its Human Subjects Committee. As part of the informed consent process participants were assured of confidentiality. The data were de-identified after collection, with participants being assigned a numerical value to protect their identity. All HIPAA compliance policies and procedures were observed and maintained during and after the study. This secondary data analysis study was also approved in kind by the Northeastern University Institutional Review Board (IRB) for review of completely de-identified, previously collected data.

All participants completed the Structured Clinical Interview for DSM-IV, non-patient version (SCID-NP; Spitzer et al., 1992) to rule out the presence of exclusionary Axis I disorders at the screening session. Participants also completed the STAS to assess trait anger levels. They completed a food palatability rating in which they rated the following foods: Snickers Bars, chocolate chip cookies, Reese’s Peanut Butter Cups, peanut butter cookies, potato chips, caramels, cheese crackers, muffins, ice cream, string cheese, chocolate cake, milk shakes, donuts, cheeseburgers, chicken nuggets and hot dogs. Participants rated each food item on a 0-10 scale (0 = “do not enjoy this food at all,” 10 = “enjoy this food extremely”). A total of three carbohydrate-rich foods and three protein-rich foods that were each
rated six or higher were later provided to participants for the experimental portion of the study to evaluate eating behavior after mood induction.

During the screening session, participants were interviewed about recent experiences during which they remembered feeling angry. They were encouraged to give very detailed descriptions of these events, including a description of events that led up to the specific incident, feelings experienced during and after the event, and then to rate each event on a Likert scale (“1” measured as low intensity, “10” measured as high intensity) for intensity of the anger experienced and vividness of the experience. Memories that were rated five or greater were recorded for later use in the experimental mood induction portion of the study. Neutral mood states were achieved by asking participants to recall engaging in a household chore that did not evoke a negative emotion (e.g., washing dishes). Participants were also asked to record their mood four times daily using the Profile of Mood States (POMS) measure for two consecutive days prior to the first study visit. Data from these assessments would later be used to compare baseline and induced mood states during the study. Before leaving the screening session participants underwent a positive mood induction, if mood did not otherwise return to baseline, assessed by a final POMS completion. Positive mood induction was performed by instructing participants to recall vividly a past experience during which they remember feeling happy. Participants were instructed to describe in detail events which led to the specific memory as well as feelings that were experienced during and following the event.
Following the screening session, participants were scheduled for two future sessions for the experimental portion of the study during which they would be induced into either anger or neutral mood states. Participants were instructed not to eat any food or drink any energy dense liquids within two hours of their scheduled study visits. Each study visit began with participants completing a POMS assessment for baseline mood data as well as a hunger rating scale from 0-10 (0 = not hungry at all, 10 = extremely hungry). Participants then underwent a mood induction of either an angry or neutral condition. The induction procedure began with the participant choosing a piece of paper from an envelope on which was written one of the topics they wrote about in the screening session. Participants were instructed to re-imagine the memory as vividly as possible. Participants were instructed to imagine the event in detail for seven minutes, including events that led up to the incident, and feelings that were experienced during and after the event. Participants then completed a POMS questionnaire to check mood and induction success, and a hunger rating. POMS and hunger rating scores were recorded and tabulated.

Participants were then presented with foods chosen from their individual ratings of palatable foods. Participants were then asked to sample as much of the food as they choose to during a 20-minute interval during which they were left alone. They were told no food could be brought home. Following the 20-minute interval participants completed a POMS questionnaire as well as another hunger rating. Each study session was concluded with a positive mood induction followed by a final
completion of a POMS questionnaire. Caloric intake was determined by measuring the amount of food consumed in grams multiplied by known caloric content per gram consumed, based on packaging materials. Foods were divided into 400 kcal portions, with 6 foods available to each participant, for a total of 2400 total calories available. Each 400 kcal portion was weighed in grams before consumption and compared to the weight after consumption to reflect the intake. The difference between the pre-session food weight and the post-session weight was then calculated and converted from grams to kilocalories. The second induction session, either anger or neutral mood (whichever one the participant had not received in the first induction session), was performed in the same manner as the first session and occurred one to six days following the first session.

**Research Questions**

1. What is the relationship of the independent variable, trait anger, as measured by the State Trait Anger Scale (STAS), to the dependent variable of eating behavior, as assessed by caloric intake following mood induction?

2. What is the relationship of the independent variable, magnitude of anger state, as measured by the difference between the pre and immediate post-mood induction POMS anger scale, to the dependent variable of eating behavior, as assessed by caloric intake following mood induction?

3. Does a multiplicative interaction effect occur between trait anger, as measured by STAS, and magnitude of state anger, as measured by the difference between pre and
immediate post-mood induction POMS anger scale, on the dependent variable of eating behavior, as assessed by caloric intake following mood induction?

4. What is the effect of the independent demographic variables and participant characteristics, gender, BMI category, marital status, income, ethnicity, size of household and education level, on the dependent variable of eating behavior, as assessed by caloric intake following mood induction?

**Data Analysis**

Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS), version 19.0. Multivariate linear regression analyses were employed to determine the correlation and variance associated with each of the independent continuous variables (e.g. trait anger, state anger). Predictor variables included trait anger (as measured by STAS), state anger (as measured by POMS difference between pre and post mood induction); these regressions were controlled for type of mood induction (anger or neutral) and order of conditions (anger or neutral induction first). Categorical demographic variables (gender, BMI category, income, level of education, size of household, and ethnicity) were each assessed by separate ANOVA analyses. Overall model analyses employed a General Linear Model (GLM), which combines linear regression and ANOVA characteristics.

All regression data analysis assumptions were evaluated. The data were assessed for normal distribution, and if not normally distributed, log transformation was performed to address degree of skew or kurtosis. The linearity of the relationship between dependent and independent variables, and the independence of
predictor variables from each other was assessed. Statistical significance of each finding and equation was confirmed with a \( p < .05 \) standard, as well as \( R^2 \) calculations for the final regression equation to determine the effect size based on the degree of variance explained in the model. In terms of the effect size, as described by Cohen (1992), it may be considered and reported in order to address the substantive, as opposed to the statistical significance of the relationships. It conveys an estimated magnitude of the relationship in the data. The magnitude of the \( R^2 \) values suggests the effect size for the regressions, while beta values were employed to demonstrate effect size for the individual variables in the model.

Any statistically significant correlation results for variables were added back to the final regression equation. A general linear model (GLM) analysis was employed for the overall model since it can incorporate ANOVA and linear regression characteristics, and produces both ANOVA statistics (F-ratio) and regression values (\( R^2 \)). Regression diagnostics were performed on the overall model to look for outlier points and points of high leverage, before the final model equation was established. Regression points were plotted to confirm linear relationships.

For research question 1, to evaluate whether there was a significant relationship between trait anger and post-induction caloric intake, a linear multivariate regression analysis was performed based on levels of trait anger and post-induction caloric intake. Linear regression analysis was employed given the continuous nature of the trait anger variable. The regression analysis assessed the
impact of trait anger (independent variable) on caloric intake post-induction (dependent variable), while simultaneously controlling for the type of mood induction (anger vs. neutral) and also the order of inductions (anger then neutral, or neutral then anger). The order of condition administration was counterbalanced in the experiment to assess for a carry-over effect (i.e., whereby the sequence of anger induction followed by the neutral induction or vice versa affects the outcome).

For research question 2, to evaluate whether there was a significant relationship between magnitude of state anger, as determined by the difference in POMS state anger score before and immediately after induction, and post-induction caloric consumption, a multivariate linear regression analysis was performed based on magnitude of anger state induced (independent variable) and post-induction caloric intake (dependent variable). Linear regression analysis was employed given the continuous nature of the magnitude of the anger state variable. The regression analysis assessed the impact of magnitude of state anger on caloric intake post-induction, while simultaneously controlling for the type of mood induction (anger vs. neutral) and also the order of induction conditions (anger then neutral, or neutral then anger inductions).

For research question 3, to evaluate the effect of both trait anger and state anger on post-induction caloric intake, a multivariate linear regression analysis was undertaken to determine if there was an interaction effect between trait anger and magnitude of state anger on post-induction caloric intake. The analysis was intended to explore for the presence of an interaction effect, a multiplicative
relationship between trait and state anger. A multivariate linear regression was conducted to determine the components of the variance in post-induction caloric intake related to trait anger (as measured by STAS), state anger (as measured by difference in POMS anger scale measurement before and immediately after induction) and the combination of trait and state anger measures (possible interaction effect). This regression was also controlled for the type of mood induction (anger versus neutral) and the order of induction conditions (anger then neutral, or neutral then anger inductions).

For research question 4, to evaluate the relationship of the demographic and participant characteristics of gender, BMI category, marital status, income, ethnicity, size of household, and educational level with eating behavior post-induction (dependent variable), a series of separate ANOVA analyses were calculated for each categorical variable.

In order to develop an overall model based on the prior analyses a General Linear Model (GLM) was employed. This incorporates several different statistical models, including ANOVA, ordinary linear regression, t-test, and F-test. Any statistically significant variables that correlated with the variance in caloric intake were added to the final regression equation. In addition to an assessment of the variance due to demographic variables, the model was controlled for the order of conditions administration (anger then neutral, or neutral then anger inductions) and the type of mood induction (anger vs. neutral). Given the large number of comparisons, an assessment of $p$ value and potential Type I error was performed.
Participant demographics collected from the study demographic questionnaire were also analyzed using tabulations and percentages for categorical variables, calculating the mean, minimum, maximum and standard deviation for continuous variables where possible and appropriate. Statistical significance using t-tests and p-values, as well as chi-square analyses, were determined to evaluate the significance of any differences in distribution of demographic characteristics in various participant cohorts based on trait or state anger.
CHAPTER FOUR: RESULTS

Results

Description of the Sample

One hundred thirty eight potential candidates were screened as part of the University of Massachusetts Medical School study entitled, “Eating and Negative Affect: The Influence of Body Mass Index and Gender.” Table 1 describes the characteristics of the sample. Overall, 61 participants (44% of those screened) were included in the study. The majority of the participants were women (74%), with a mean age of 34.6 years. Forty nine percent of participants were not married (single). The majority of participants had some higher education (bachelors degree or higher for 66%), were mostly Caucasian (82%), had two or more people living in their household (78%) with mean of 2.77 (SD = 1.8, Range = 1 - 12), and had income over $40,000 (58%). BMI (BMI = kg/m$^2$) was divided into two categories, with 39% in the lean group (BMI < 25) and 61% in the obese group (BMI ≥ 30). Overall mean BMI was 27.55 (SD = 6.59, Range = 19.0 - 42.9). Table 2 describes the exclusion categories for the screened candidates, with the leading cause of exclusion being unresponsiveness to mood induction (64%).
Table 1

Demographic Characteristics of Sample (n = 61)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>16</td>
<td>26</td>
</tr>
<tr>
<td>Female</td>
<td>45</td>
<td>74</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>19</td>
<td>31</td>
</tr>
<tr>
<td>Living with Partner</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Single</td>
<td>30</td>
<td>49</td>
</tr>
<tr>
<td>Divorced</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td><strong>Education Level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Trade or Specialty School</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Some College</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>Associates Degree</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Bachelors</td>
<td>18</td>
<td>30</td>
</tr>
<tr>
<td>Some Graduate School</td>
<td>11</td>
<td>18</td>
</tr>
<tr>
<td>Master’s Degree</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Professional or Doctorate Deg.</td>
<td>5</td>
<td>8</td>
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</table>
### Table 1 (Continued)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>50</td>
<td>82</td>
</tr>
<tr>
<td>African American</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Asian</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Multi-Ethnic</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Size of Household</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>13</td>
<td>22</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>31</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Missing data</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Characteristic</td>
<td>N</td>
<td>Percentage</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----</td>
<td>------------</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 – 15,000</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>15,000 – 25,000</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>25,000 – 30,000</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>30,000 – 35,000</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>35,000 – 40,000</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>40,000 – 45,000</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>45,000 – 50,000</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>50,000 – 60,000</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>60,000 – 75,000</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>75,000 and above</td>
<td>17</td>
<td>28</td>
</tr>
<tr>
<td>Missing data</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>BMI Category</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25</td>
<td>24</td>
<td>39</td>
</tr>
<tr>
<td>≥30</td>
<td>37</td>
<td>61</td>
</tr>
</tbody>
</table>
Table 2
Exclusionary Criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>N</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Follow-Up</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Unresponsive to Induction</td>
<td>49</td>
<td>64</td>
</tr>
<tr>
<td>Substance Abuse</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Uninterested</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Medication Exclusion</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Diabetes Exclusion</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Non-Qualifying BMI*</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>Medical Condition</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Pregnant or Lactating</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total Excluded</td>
<td>77</td>
<td>100</td>
</tr>
<tr>
<td>Total Included in Study</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>Total Screened</td>
<td>138</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Non-Qualifying BMI = 25 - 30

Caloric Intake Results

Table 3 describes the caloric intake for all participants following the anger mood induction (M = 996 calories, SD = 317) and the neutral mood induction (M = 1000 calories, SD = 364). There was no significant difference in the caloric intake of participants based on the mood induction administered (t = -.07, p = .95).
Table 3

*Post Induction Caloric Intake*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Anger Induction</th>
<th>Neutral Induction</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>61</td>
<td>61</td>
</tr>
<tr>
<td>Mean</td>
<td>996.14</td>
<td>1000.23</td>
</tr>
<tr>
<td>SD</td>
<td>317.47</td>
<td>363.80</td>
</tr>
<tr>
<td>Range</td>
<td>438.9 – 1834.4</td>
<td>21.2 – 2183.0</td>
</tr>
</tbody>
</table>

\[ t = -0.07 \]

\[ df = 120 \]

\[ p-value = 0.95 \]

**Trait Anger**

Trait anger scores based on STAS were evaluated at time of participant screening (M = 27.6, SD = 6.5), as described in Table 4. The cohort (n = 37) that received the anger induction first (M = 26.4, SD = 6.4) was compared with the cohort (n = 22) that had the neutral induction first (M = 29.5, SD = 6.4). T-tests indicated that there was no significant difference between the two groups in trait anger score (\( t = -1.80, p = 0.08 \)). STAS scores were not available for two of the participants.
Table 4

Trait Anger Scores

<table>
<thead>
<tr>
<th>Parameter</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>59</td>
<td>27.6</td>
<td>6.5</td>
<td>15.0</td>
<td>49.0</td>
</tr>
<tr>
<td>Anger First</td>
<td>37</td>
<td>26.4</td>
<td>6.4</td>
<td>15.0</td>
<td>49.0</td>
</tr>
<tr>
<td>Neutral First</td>
<td>22</td>
<td>29.5</td>
<td>6.4</td>
<td>20.0</td>
<td>48.0</td>
</tr>
</tbody>
</table>

\[ t \quad -1.80 \]
\[ df \quad 57 \]
\[ p\text{-value} \quad 0.08 \]

Hypothesis 1, which stated, trait anger will be significantly correlated with post-mood induction caloric intake, such that higher trait anger will be associated with higher levels of post-induction caloric intake was tested via multivariate linear regression analysis that included the variable of trait anger (STAS score), while also controlling for type of induction (anger or neutral mood) and order of conditions (anger or neutral mood induction first). Hypothesis 1 was not supported based on this analysis \([F(df = 1) = 1.79, p = .18]\). Type of induction and order of conditions were also not significantly correlated.

State Anger

State anger was analyzed by comparing pre-induction anger subscales POMS scores with post-induction anger subscales POMS scores. Table 5 describes the POMS difference for both the state anger induction and the neutral mood inductions.
POMS scores in the anger induction condition increased from the pre-induction test 
(M = 1.89, SD = 4.37) to the post-induction test (M = 17.57, SD = 11.16). The 
difference in the anger induction POMS scores between pre-induction and post-
induction was used as a measure of magnitude of state anger (M = 15.69, SD = 
10.83, $p < .0001$). In terms of the neutral induction condition, pre-neutral induction 
POMS scores (M = 1.46, $SD = 2.72$) were compared with post-neutral induction 
POMS scores (M = 1.33, $SD = 2.62$). The difference between pre and post-neutral 
induction POMS scores was minimal (M = -0.13, $SD = 3.01$, $p = .73$).

**Table 5**

*State Anger Scores*

<table>
<thead>
<tr>
<th>Induction</th>
<th>Parameter</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>Pre-test score</td>
<td>122</td>
<td>1.67</td>
<td>3.63</td>
<td>0-20</td>
</tr>
<tr>
<td></td>
<td>Post-test score</td>
<td>122</td>
<td>9.45</td>
<td>11.47</td>
<td>0-44</td>
</tr>
<tr>
<td></td>
<td>Difference</td>
<td>122</td>
<td>7.78</td>
<td>11.21</td>
<td>-10-43</td>
</tr>
<tr>
<td>Anger</td>
<td>Pre-test score</td>
<td>61</td>
<td>1.89</td>
<td>4.37</td>
<td>0-20</td>
</tr>
<tr>
<td></td>
<td>Post-test score</td>
<td>61</td>
<td>17.57</td>
<td>11.16</td>
<td>0-44</td>
</tr>
<tr>
<td></td>
<td>Difference</td>
<td>61</td>
<td>15.69</td>
<td>10.83</td>
<td>-3-43</td>
</tr>
<tr>
<td>Neutral</td>
<td>Pre-test score</td>
<td>61</td>
<td>1.46</td>
<td>2.72</td>
<td>0-13</td>
</tr>
<tr>
<td></td>
<td>Post-test score</td>
<td>61</td>
<td>1.33</td>
<td>2.62</td>
<td>0-17</td>
</tr>
<tr>
<td></td>
<td>Difference</td>
<td>61</td>
<td>-0.13</td>
<td>3.01</td>
<td>-10-13</td>
</tr>
</tbody>
</table>
Hypothesis 2, which stated that magnitude of state anger will be significantly correlated with post-mood induction caloric intake, such that higher state anger will be associated with higher levels of post-induction caloric intake was evaluated with a multivariate linear regression analysis. The variables entered into the model included change in POMS score from pre-induction to post-induction (state anger measure), while also controlling for type of mood induction (anger or neutral mood) and sequence of inductions (anger or neutral induction first). The regression revealed the change in POMS score was significantly associated with caloric intake [state anger measure; \( p = .04 \)]. The raw POMS state anger correlation with calorie intake was \( r = -0.14 \) \( (p = .136) \). However, in the regression, when controlling for the other two variables, sequence of inductions \( (p = .76) \) and type of induction \( (p = .16) \), state anger (as measured by the change in POMS score) was significantly associated with caloric intake (results shown in Table 6). The beta value of -8.07 suggests that higher state anger actually resulted in lower caloric consumption. The \( R^2 \) value for this regression was .035. The low \( R^2 \) value suggests that magnitude of state anger accounted for only a small amount of the overall variance in caloric intake in participants in this experimental manipulation. This result is not as predicted in the hypothesis; while there was a weak correlation between caloric intake and state anger, it was a negative relationship, and not a positive relationship as predicted.
Table 6

*State Anger Effect on Calorie Intake*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>SE (B)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1011.56</td>
<td>59.49</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Order of conditions: Anger first</td>
<td>-19.38</td>
<td>63.85</td>
<td>0.76</td>
</tr>
<tr>
<td>Order of conditions: Neutral first</td>
<td>0.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Anger manipulation</td>
<td>123.51</td>
<td>86.81</td>
<td>0.16</td>
</tr>
<tr>
<td>Neutral manipulation</td>
<td>0.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>State anger score</td>
<td>-8.07</td>
<td>3.89</td>
<td>0.04</td>
</tr>
</tbody>
</table>

R² = 0.035, f = 1.45, p = 0.23

*State and Trait Anger Interaction*

Hypothesis 3 stated trait anger and state anger will interact such that participants with higher levels of both trait anger and state anger will exhibit higher levels of post-induction caloric consumption than would be expected due to either trait or state anger level alone. The hypothesis was evaluated with a multivariate linear regression analysis. The variables entered into the model included: STAS score (trait anger), POMS difference (state anger), an interaction term for STAS score and POMS difference, type of mood induction, and order of mood induction.
administration. There was no significant interaction found for trait anger (STAS score) and state anger (POMS difference) in relation to post-induction caloric intake [F(df = 1) = 1.05, \( p = 0.31 \)]. None of the other variables in the model were statistically significant, in relation to caloric intake, including POMS difference (\( p = .11 \)), STAS score (\( p = .57 \)), type of induction (anger or neutral) (\( p = .15 \)), and order of conditions (\( p = .74 \)). The R\(^2\) value for this model was low (R\(^2\) = 0.059).

**Demographic Factors**

Hypothesis 4 stated participant gender will account for some of the variance observed in post-induction caloric intake. However, BMI category, marital status, income, ethnicity, size of household and education level will not be significantly related to the variance in post-induction caloric consumption. Separate ANOVAs were performed to test whether the calories consumed post-induction differed among each of these demographic factors. Demographic variables [gender, marital status, education level, ethnicity, size of household, income and BMI category (participants divided into high and low BMI categories)] were assessed for 57 of 61 participants for whom complete data were available to test this hypothesis. The sequence of inductions (anger or neutral induction occurring first) and type of induction (anger or neutral) were also included as covariates in the model to control for these factors. As described in Table 7, of all the demographic factors assessed, only gender was significant (\( p = .0025 \)), with more calories consumed by men (M = 1230, SD = 362) compared to women (M = 916 calories, SD = 292). The finding that men consumed more calories than women was also present and significant in the neutral induction
condition. There was no significant difference among the calories consumed post-induction for the categories of the other demographic factors examined: marital status \((p = .09)\); education \((p = .22)\), ethnicity \((p = .27)\); size of household \((p = .21)\), income \((p = .68)\), BMI category \((p = .53)\), and sequence of inductions \((p = .28)\).

Hypothesis 4 was confirmed based on the analysis described above and the finding that men consumed significantly more calories post induction.

**Table 7**

**ANOVA Analyses of Demographic Variables’ Association with Caloric Intake**

<table>
<thead>
<tr>
<th>Variable</th>
<th>df</th>
<th>F-ratio</th>
<th>(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>1</td>
<td>11.30</td>
<td>0.0025</td>
</tr>
<tr>
<td>Marital Status</td>
<td>3</td>
<td>2.43</td>
<td>0.09</td>
</tr>
<tr>
<td>Education</td>
<td>7</td>
<td>1.47</td>
<td>0.22</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>3</td>
<td>1.38</td>
<td>0.27</td>
</tr>
<tr>
<td>People in Household</td>
<td>6</td>
<td>1.52</td>
<td>0.21</td>
</tr>
<tr>
<td>Income</td>
<td>9</td>
<td>0.73</td>
<td>0.68</td>
</tr>
<tr>
<td>BMI group</td>
<td>1</td>
<td>0.41</td>
<td>0.53</td>
</tr>
<tr>
<td>Order of Conditions</td>
<td>1</td>
<td>1.24</td>
<td>0.28</td>
</tr>
</tbody>
</table>
Exploratory Analyses of Gender

Based on the significant relationship between gender and caloric intake, the association was examined in greater detail. First, calories consumed post induction were examined separately for each sex. Men consumed similar amounts of calories following the anger induction ($M = 1220$ calories, $SD = 343$) and the neutral induction ($M = 1240$, $SD = 391$), which were not significantly different from each other ($t = -0.16$, $p = 0.87$). The mean calorie intake for women following the anger induction ($M = 917$ calories, $SD = 270$) was similar to the amount following the neutral induction ($M = 915$ calories, $SD = 316$) and these were not significantly different from each other ($t = 0.03$, $p = 0.98$). Thus, male participants had higher caloric intake than female participants overall, and this finding held true regardless of the type of mood induction.

Given the significance of gender in the analyses, a linear regression analysis was conducted with the gender variable alone, together with the type of induction and order of conditions [using a general linear model (GLM)]. Whereas gender was significant at $p = 0.0025$ level in the analysis described in Table 7, this analysis found gender to have a stronger association with caloric intake, when controlling for type of induction and order of inductions ($p < .0001$, model $R^2 = .17$). Men consumed more than women, regardless of the type of induction or sequence of inductions.

Given the significant findings related to gender alone, a detailed analysis of gender distribution among high and low trait and state anger participants was examined. The analysis was undertaken to make certain that gender differences were
not confounding trait or state anger results. The analysis focused on whether males and females were proportionally distributed among high and low trait and state anger participants. Participants were divided by trait anger (STAS) score, those above the sample’s median STAS score of 27 \( (n = 32, 52\% \text{ of sample}) \), and those below \( (n = 29, 48\% \text{ of sample}) \). Further analyses divided these high and low trait anger groups by gender. A Chi Square test was performed to examine gender by trait anger score to determine whether the gender proportions were equal within the high and low trait anger groups. The test found no significant difference in the proportion of males and females within the high and low trait anger groups \( (\chi^2 = 0.66, p = 0.42) \). Thus, males and females are equally distributed among the high and low trait anger groups, and therefore gender would not confound the relationship between trait anger and emotional eating.

A similar analysis to evaluate gender distribution and its relationship to state anger was conducted. The participant sample was divided by state anger score (POMS difference) into high and low cohorts. Further analyses divided these high and low POMS difference groups by gender and found no significant difference in the proportion of males and females among the high and low POMS difference groups \( (\chi^2 = 1.25, p = 0.26) \). Thus, gender would not confound the relationship between state anger and emotional eating.
Overall Model

An overall regression was performed for state anger, trait anger, the interaction of state and trait anger, gender, order of conditions and type of induction. This model was analyzed to test the association between state and trait anger with emotional eating, while controlling for order of conditions, type of induction, and additionally, gender, since gender was shown to be a significant covariate. This analysis revealed state anger (POMS difference) was no longer significant \( F(df = 1) = 3.67, p = .058 \). The other variables, trait anger as measured by STAS score \( F(df = 1) = .09, p = .76 \), the interaction \( F(df = 1) = 2.30, p = .13 \), sequence of inductions \( F(df = 1) = .03, p = .87 \), and type of induction \( F(df = 1) = 1.30, p = .26 \), did not reach significance. As noted, in this analysis the state anger variable was no longer significant, with the \( p \) value increasing from .04 to .058. Gender remained significant with \( p < .0001 \). The overall \( R^2 \) value for the equation was .23 (\( p < .0001 \)), as in Table 8.
Table 8

*Overall Model: State and Trait Anger, and Demographics Predicting Caloric Intake*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>SE (B)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>875.4104794</td>
<td>167.7641394</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Male gender</td>
<td>322.0702258</td>
<td>65.2967956</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Female gender</td>
<td>0.0000000</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Order of conditions: Anger first</td>
<td>9.9123551</td>
<td>59.7821705</td>
<td>0.8686</td>
</tr>
<tr>
<td>Order of conditions: Neutral first</td>
<td>0.0000000</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Anger manipulation</td>
<td>90.5533966</td>
<td>79.4390914</td>
<td>0.2568</td>
</tr>
<tr>
<td>Neutral manipulation</td>
<td>0.0000000</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>State anger score</td>
<td>-22.2535006</td>
<td>11.6172539</td>
<td>0.0580</td>
</tr>
<tr>
<td>Trait anger score</td>
<td>1.6959071</td>
<td>5.5529904</td>
<td>0.7606</td>
</tr>
<tr>
<td>State anger*trait anger interaction effect</td>
<td>0.5792319</td>
<td>0.3822756</td>
<td>0.1326</td>
</tr>
</tbody>
</table>

$R^2 = 0.23, f = 5.47, p < 0.0001$

**Regression Diagnostics for the Overall Model**

In order to more fully assess the reliability of the overall model, regression diagnostics were performed on the data derived in the model development. These diagnostics were conducted once a full version of the overall regression model was established, since analysis of residuals is based on the model itself. Important model
components were identified in earlier analyses. Diagnostics looking for the fit of overall model, verification of assumptions and presence of outliers in the data set were conducted. The diagnostics consisted of statistical tests, some numerical and some graphical.

**Studentized Residuals of the Data.** A studentized residual was calculated based on the difference between points’ predicted values based on the regression equation versus the actual value of the data divided by an estimate of its standard deviation (for normalization). All observations where residuals were greater than 2 or less than -2 were summarized. There were six observations (of 61 total) where the residuals were greater than 2 or less than -2, which were further evaluated. Three of those observations had residual values greater than 3 or less than -3.

**High Leverage Points.** Data points with high leverage that have the greatest influence on the model were identified. Points at the extremes of the distribution have more leverage, as do outlying observations. A point with leverage greater than \((2k+2)/n\) was assessed further, hence in this model, leverage points greater than 0.1186 were examined (Belsley, Kuh, & Welsch, 1980). Five observations from 4 participants were identified as having high leverage greater than 0.1186.

**Points with High Influence.** Cook’s d statistic was used to evaluate the shift in an estimate when a given point was removed from the model. Cook’s d statistic was also used to search for data points with high influence on the model. The conventional cut-off point for Cook’s d statistic is 4/n, so values above 0.034 were
examined (Boland & Jackman, 1990). Six observations had Cook’s d values above 0.034.

In all, there were 12 observations that passed the cut points for outliers, as described in Table 9.

**Table 9**

*Outliers: Values with High Leverage, Residual, or Cook’s D Values*

<table>
<thead>
<tr>
<th>ID</th>
<th>Calorie</th>
<th>Residual</th>
<th>Cook’s D</th>
<th>Leverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>102</td>
<td>21.19</td>
<td>-3.30719</td>
<td>0.072647</td>
<td>0.04158</td>
</tr>
<tr>
<td>110</td>
<td>399.53</td>
<td>-3.08487</td>
<td>0.077870</td>
<td>0.05018</td>
</tr>
<tr>
<td>153</td>
<td>1169.21</td>
<td>-0.88334</td>
<td>0.024267</td>
<td>0.15700</td>
</tr>
<tr>
<td>153</td>
<td>1261.89</td>
<td>-0.45473</td>
<td>0.006317</td>
<td>0.15397</td>
</tr>
<tr>
<td>158</td>
<td>711.74</td>
<td>-0.17322</td>
<td>0.000745</td>
<td>0.12872</td>
</tr>
<tr>
<td>124</td>
<td>774.62</td>
<td>-0.14154</td>
<td>0.000506</td>
<td>0.13059</td>
</tr>
<tr>
<td>109</td>
<td>964.11</td>
<td>0.73294</td>
<td>0.012765</td>
<td>0.12434</td>
</tr>
<tr>
<td>126</td>
<td>1377.69</td>
<td>1.30710</td>
<td>0.037174</td>
<td>0.11612</td>
</tr>
<tr>
<td>142</td>
<td>1792.23</td>
<td>2.00258</td>
<td>0.049433</td>
<td>0.07058</td>
</tr>
<tr>
<td>155</td>
<td>1532.09</td>
<td>2.05471</td>
<td>0.018932</td>
<td>0.02693</td>
</tr>
<tr>
<td>144</td>
<td>1740.12</td>
<td>2.80874</td>
<td>0.083378</td>
<td>0.06307</td>
</tr>
<tr>
<td>104</td>
<td>2182.96</td>
<td>3.38436</td>
<td>0.091060</td>
<td>0.04957</td>
</tr>
</tbody>
</table>
Test for Normality of Residuals. An evaluation was performed to confirm that residuals in the model were normally distributed. The residuals were plotted (Figure 1) and a Q-Q plot was created to visually inspect the residuals (Figure 2). The Q-Q plot shows the quantiles of the data from the actual sample versus theoretical quantiles from a normal distribution. If the residuals are normally distributed, the plot will appear to be roughly linear. The Q-Q plot of the overall model data showed some skewness in the tails of the distribution. The Shapiro-Wilk test was performed in order to ensure that the residuals in the sample were normally distributed. The result was close to being statistically significant ($W = 0.979, p = 0.059$), implying that the points were not normally distributed.

Figure 1

Plot of Residuals to Assess for Normal Curve
Adjust Model Based on Diagnostic Results. There were 12 observations that met one of the criteria described above to identify outlying data. When the 12 observations meeting the criteria for the procedures described above (examination of residuals, points of high leverage, and influence) were removed from the model, the Shapiro-Wilk test statistic was not significant ($W = 0.989, p = 0.56$), and the Q-Q plot adhered much more closely to normally distributed residuals, as shown in Figure 3. This means that while the initial distribution of residuals had some skewness, when outliers and points of high leverage were removed a normal distribution was
achieved, allowing for regression analysis of this data set to produce meaningful results.

**Figure 3**

*Q-Q Plot with Outliers Removed*

![Q-Q Plot with Outliers Removed](image)

**Test Model for Heteroscedasticity.** Another important assumption that was tested for the regression model was for heteroscedasticity, which implies that the variance of the residuals is homogenous, and is not clustered or otherwise skewed. The White test was performed on the model with outliers and points of high influence removed from the dataset to test for heteroscedasticity. The test was non-significant ($\chi^2 = 13.07, \text{df} = 18, p = 0.79$), which confirms this assumption. This
means that the variance of residuals with outliers removed is fairly homogeneous and that linear regression analysis can provide meaningful results in this data set.

**Test for Linear Relationship in Data.** Another critical assumption that was tested was to ensure a linear relationship between the independent variables in the model and the dependent variable (caloric consumption). Plots were generated of values of state anger and trait anger by calories consumed, using the dataset with outliers and points of high leverage removed. As drawn in Figure 4, the plot of trait anger was visually inspected to ensure a linear relationship, and a regression line was fitted to assess the linear relationship. Inspection of the plot did reveal a linear relationship between trait anger and caloric intake. Hence linear regression analysis of these data is a meaningful process. In particular, it is apparent upon inspection that there is a direct relationship between higher levels of trait anger and higher levels of caloric intake, as shown in Figure 4. A similar procedure for state anger was also performed. The relationship between state anger and caloric intake is less robust and inverse in nature, such that higher POMS difference scores (state anger) were related to lower levels of caloric intake.
Final Model Regression Analysis Based on Relationship Between Trait Anger, State Anger, and Gender with Outliers Removed

Following regression diagnostics and omission of identified outlier points and points of high leverage, the final model was developed and tested. Trait anger score (based on STAS), state anger score (based on POMS difference), gender, type of mood induction (negative and neutral), and order of administration (anger or neutral mood induction first) were independent variables in the model predicting the dependent variable of calories consumed following mood induction, as described in Table 10. The interaction effect variable between state and trait anger score was
removed since it was earlier found to be non-significant. In this final model with outliers and points of high influence removed, trait anger score was significantly related to caloric intake ($p = 0.0008$) such that higher trait anger was associated with higher caloric intake. The model estimates that for every increase in trait anger score (STAS score) of 1, the average number of calories consumed post mood induction increased by 15 calories. Gender remained significantly correlated to caloric intake ($p < 0.0001$). Order of mood induction conditions (anger or neutral induction first) approached significance $[F(df = 1) = 3.44, p = 0.066]$, where participants who had the anger mood induction first consumed 96 calories more than those who had the neutral mood induction first. State anger score based on POMS difference was no longer significant with outliers removed $[F(df = 1) = 2.48, p = 0.12]$. Type of mood induction (anger vs. neutral) was also not significant $[F(df = 1) = 0.40, p = .53]$. The $R^2$ for the final regression equation was .32 ($p < .0001$).
Table 10

*Final Overall Regression with Outliers Removed*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>SE(B)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>457.7907628</td>
<td>139.3048972</td>
<td>0.0014</td>
</tr>
<tr>
<td>Male gender</td>
<td>320.7195317</td>
<td>56.0898805</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Female gender</td>
<td>0.0000000</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Order of conditions: anger first</td>
<td>95.7668466</td>
<td>51.6041202</td>
<td>0.0664</td>
</tr>
<tr>
<td>Order of conditions: neutral first</td>
<td>0.0000000</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Anger manipulation</td>
<td>43.2871401</td>
<td>68.6260212</td>
<td>0.5296</td>
</tr>
<tr>
<td>Neutral manipulation</td>
<td>0.0000000</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>State anger score</td>
<td>-5.5082421</td>
<td>3.5011487</td>
<td>0.1188</td>
</tr>
<tr>
<td>Trait anger score</td>
<td>15.4078967</td>
<td>4.4704982</td>
<td>0.0008</td>
</tr>
</tbody>
</table>

$R^2 = 0.32$, $f = 9.59$, $p < 0.0001$
CHAPTER FIVE: DISCUSSION

Overview of Results

This study, a laboratory-based experimental anger mood induction procedure, was conducted on a sample of 61 participants. Statistical analyses were conducted to examine the effect of trait anger (based on STAS scores), state anger (based on pre- and post-anger mood induction POMS score differences), and demographic variables on calories consumed following anger and neutral mood inductions.

Initial results of linear regression analyses suggested that trait anger (based on STAS score) was not significantly related to caloric intake following mood induction. Once the initial overall model was available, detailed analyses were conducted in order to confirm regression assumptions, and evaluate the impact of outlier and high leverage points. Following regression diagnostics, and removal of outliers and high leverage points, trait anger was found to demonstrate a significant relationship to caloric intake following mood induction, indicating that for every one point increase in STAS, there was an increase of 15 calories consumed.

Results of the initial linear regression analyses suggested that state anger was negatively correlated to caloric intake following anger induction, at the level of a trend; however, with outlier and high leverage points removed in the final regression model, state anger was no longer significantly related to caloric intake. Hence, the degree of anger state experienced was not related to the magnitude of calories consumed. These findings taken together suggest that intrinsic proclivity to become
angry, or trait anger, may be a much more relevant factor in predicting emotional eating than the magnitude of state anger, a more transitory experience.

The initial regression model did not indicate significance for the order of conditions variable. The final regression model with outliers and high leverage points removed approached significance for the sequence of inductions, suggesting that anger induction first resulted in slightly higher caloric intake. However, this finding did not achieve statistical significance and its relevance to the laboratory-based results is likely minimal. Its relevance would be even less certain outside of a laboratory setting.

An interaction effect between trait anger and state anger was assessed but was not significant in the linear regression analysis. Hence in this study the two independent variables, trait and state anger, did not have a multiplicative or synergistic relationship in terms of post-induction caloric intake that was greater than the variance that either would account for independently.

ANOVA of demographic variables revealed that significant variance in caloric intake post-induction was related to gender, with men consuming more calories than women. This finding held true for both the anger and neutral mood inductions. When gender alone was evaluated in a regression analysis related to caloric intake (without other demographic variables considered) the result was significant ($p < .0001$). However, gender did not seem to play a role related directly to anger, but instead men in this study consumed more than women for all types of
induction. No other demographic variables were significantly related to caloric intake.

The final regression model, which included trait anger, state anger, gender, type of induction, and order of conditions, with outliers and points of high leverage removed following regression diagnostics, produced an $R^2$ of .32. This suggests that nearly one-third of the overall variance in caloric intake among participants was accounted for in the regression model by these variables. These results indicated that a one-point increase in the trait anger STAS score predicted an increase of 15 additional calories consumed under the experimental mood induction condition. The results may suggest the importance of trait anger as a significant and measurable variable in the evaluation of potentially maladaptive emotional eating behavior.

**Relationship of Results and Emotional Eating Theories**

Trait anger is typified by a proclivity for frequent episodes of anger that are characterized by high intensity and long duration in the setting of emotional stress. The results described here suggest that emotional eating behavior may be related to trait anger. According to the affect regulation theory, emotional eating may be thought of as a coping response to regulate uncomfortable negative emotions (Arnow, Kenardy, & Agras, 1995; Telch & Agras, 1996). The finding that trait, rather than state, anger is associated with emotional eating behavior suggests that an enduring personality trait matters more than a transient emotional state in contributing to emotional eating. This theory builds upon the notion that over time there is a learned association between negative mood and strategies for reduction of
negative affect. Emotional eating may be thought of as a strategy for reduction of this negative affect. This link between negative mood and strategies for alleviation of negative affect may develop over many years. Episodes of state anger alone, without long standing trait related coping strategies, do not seem to correlate with emotional eating. In fact, in the results described, higher levels of state anger were associated with lower levels of caloric intake, though not reaching statistical significance.

The present study corroborates previous research on trait anger that demonstrated a relationship between trait anger, or proclivity to have anger states, and emotional eating (Waller et al., 2003). Waller and colleagues conducted a retrospective self-report questionnaire study that established an association between high trait anger and maladaptive eating patterns such that those who reported higher trait anger were more likely to engage in binge/purge behaviors as measured by the Young Schema Questionnaire (YSQ-S; Young, 1994). The self-report questionnaire evaluates 15 sub-scales including measures such as subjugation, enmeshment, shame, failure to achieve, emotional dependence, and unrelenting self-imposed standards.

There is also prior research on the impact of trait anger and eating-related physiological medical problems. Eng and colleagues (2003) conducted a prospective self-report questionnaire study that revealed that healthy men with high levels of underlying trait anger as measured by Spielberger’s Anger-Out Expression Scale (1998) were at higher risk of developing cardiovascular heart disease. Given that
chronic physiological problems like hypertension develop over many years, it is logical that behavioral contributors such as emotional eating and obesity might be more likely to emanate from enduring trait anger features, rather than episodic and sporadic emotional states.

Macht (1999) studied anger as distinct from other negative emotions, such as sadness and fear, and found that anger can be more impactful on emotional eating than other negative emotions. The results described in the current study suggest the importance of trait anger in emotional eating behavior. Anger is more physiologically activating than sadness or fear and hence is more likely to stimulate an emotional eating response. Anger can stimulate “fight or flight” arousal, which drives more emotional behavior generally, whereas other emotions such as sadness tend to result in physiological slowing and restriction of appetite.

The current study failed to demonstrate a statistically significant relationship between state anger and emotional eating. This is in contrast to a negative mood induction study conducted by Jansen et al. (2008). Jansen and colleagues studied negative and neutral mood inductions in order to evaluate high versus low negative mood subtypes in obese and lean participants. This study employed an abbreviated POMS tool and found that obese participants high in negative affect state consumed more calories in the negative mood induction state than did individuals low in negative affect. Lean participants did not demonstrate these findings, regardless of their level of affect. Hence, unlike the results of the current study, Jansen described results where high state negative affect contributed to emotional eating.
The Jansen study has several critical differences with the study presented here. One, the “negative affect” studied by Jansen was a global blend of emotions based on a negative mood induction, including sadness, loneliness, and helplessness. Anger itself was not measured, or distinctly identified in the state emotions studied. There are significant physiological and psychological differences between the emotionally activating experience of anger compared to sadness, loneliness or helplessness. The results described in the current study highlight the potential importance of evaluating anger separately from other negative emotions, since anger may not have the same effect as a more heterogeneous group of negative emotions.

Two, Jansen looked at state emotions but did not evaluate the potentially important impact of underlying and enduring emotional traits. And lastly, Jansen described important differences based on whether the participants were obese or lean. In the current study, this variable failed to reach statistical significance. State anger was not related to emotional eating, regardless of obese or lean body type.

Anger may also be considered from the perspective of motivation. Anger may result when individuals are denied desired outcomes for specific goal oriented activities (Bushman, 2002). Individuals with high trait anger are more likely to experience anger in these settings. Emotional eating may serve to allow these individuals attainment of an alternative goal, related to satiety. The alternative goal attainment is repeated over years of frequent anger episodes, of all magnitudes. In the current study higher levels of state anger were not associated with emotional eating. It may be that for these participants, even though a state of anger may be
severe, and attainment of a goal oriented activity frustrated, they do not turn to emotional eating as an alternative goal oriented activity. Using this construct, it is the chronic experience of anger that leads to development of emotional eating as an alternative achievement.

Restraint theory (Herman & Polivy, 1980) suggests that chronic deprivation resulting from restriction of food, such as dieting and ignoring physiologic hunger, can lead to disinhibited eating in the face of stressors. While the current study was not specifically designed to test this theory, there was no evidence of a difference in caloric intake between high and low state anger participants. Furthermore, trait anger differences among participants seem unlikely to be related to chronic food deprivation given that the current study included only non-clinical participants, and there was no psychological or physiological data collected suggesting chronic food deprivation in the participants, related to trait or state anger levels. Exclusion criteria for participants included any individuals with restrictive diets or eating disorders. In the results described here, there was a linear relationship between trait anger and emotional eating response. Trait anger or the propensity to become angry in response to stressors is unlikely to have the same cadence as cycles of chronic food deprivation. It is difficult to incorporate cycles of chronic food deprivation into the otherwise continuous and linear relationship described here between trait anger and emotional eating.

In escape theory (Heatherton & Baumeister, 1991; Spoor, 2007), emotional eating functions for participants to distract or escape from negative self awareness.
Overeating occurs in response to stimuli that are perceived as threatening to one’s sense of self, such as negative cognitions. Threat to ego or of personal failure is the driver of this response. In the current study, there was no direct assessment of a threat to ego. Anger was induced by recall of prior life events. However, to the extent that such events were threatening at the time, it could be that their recall might create the environment for escape. Nonetheless, the results described in the current study did not demonstrate a relationship to magnitude of state anger, which might be expected if escape theory were playing a role. More severe anger states might be expected to drive more need to escape the threat to ego with emotional eating. In these results, even severe anger states were not related to emotional eating. Rather, trait anger, the proclivity to become angry at even low level stressors where there would be much less need to “escape,” was related to emotional eating. If trait anger is to be formulated in relation to “escape” theory, it must function in a more continuous fashion, where baseline levels of negative self awareness are being distracted by frequent outbursts of anger, and resultant emotional eating.

**Relationship of Results and Gender**

Prior studies have suggested that gender may play an important role in emotional eating behavior (Piquero & Fox, 2010). The findings from the current study suggest a significant role for gender in the observed eating behavior, in both the anger and neutral mood inductions. Hence, eating behavior related to gender was not specific to the type of induction. This finding does not align with previous work that suggested differential behavior between men and women in relation to anger.
For example, Penas-Lledo, Fernandez, and Waller (2004) demonstrated significant differences in the way in which men and women behave in response to anger. Based on self-report measures of non-clinical participants, women with high levels of trait anger were more likely to engage in binge eating whereas men were more likely to engage in other impulsive behaviors and self harm. Zellner (2006) studied non-clinical participants based on self-report questionnaires that measured compulsive eating and stress levels and found that women reported (or were observed to have) increased food consumption in response to anger, compared to men who tended to eat less. Macht, Roth and Ellgring (2002) found that men reported lower levels of hunger in response to negative mood based on a mood induction study that employed short film clips to induce anger, fear, sadness and joy.

Despite findings in the literature, the current experimental study did not confirm the same impact of gender related to the experience of anger. Studies in the past suggested that women would increase caloric intake in the setting of anger. In the current study men ate more than women following both the anger and neutral inductions. This would indicate that increased consumption was not related to emotion for men in this study. It could also be that the experimental setting itself was less threatening or more accommodating to men than to women regarding food consumption. While Macht used short film clips to induce negative emotions, the current study employed self recall of prior life experiences. It is possible that men were less able to engage in this induction behavior than women, or that it is less impactful, regardless of the type of emotion recalled.
Studies by Milovchevich, Howels, Drew, and Day (2001) had non-clinical participants evaluate short vignettes and used ratings to assess differences in anger manifestations based on gender role identification. Men were perceived as more likely to behave in a certain way than women, simply based on societal norms. The implication is that gender-associated response to stressors is related at least in part to perceived societal norms and expectations based on gender.

The impact of this sort of role identification may be more or less relevant in the laboratory setting. The design employed in the current study is much more anonymous and solitary than may occur in many social settings, and gender roles are less well defined in this environment. For example, while there may be societal expectations or norms related to a woman or man’s experience of anger in social settings, this may be completely different in the confidential and private environment of the laboratory. Alternatively, the participants’ awareness of close scientific laboratory observation may distort and even amplify traditional gender related roles. Either way, distorted or enhanced gender roles may be contributing to the lack of a recognizable relationship between gender and anger.

Gender differences in general eating behavior have been observed by other investigators. Rolls et al. (1991) described gender differences in food intake and selection which first appear in adolescence. Men consume more calories, which was supported in this study, and the sexes have different eating styles, with women socialized to eat in a more “feminine manner.” Women experience more food related conflict than men do, in particular “preferring more fattening foods but
perceiving they should not eat them.” Women have more dissatisfaction in their body weight and shape than men. Eating disorders are more prevalent in women. This study confirmed the finding of greater caloric intake by men than women.

Prior studies have not examined the precise combination of variables studied here and their contribution to emotional eating. In particular, trait anger has not been previously evaluated in combination with degree of experimentally induced state anger. Furthermore, very few studies have evaluated the impact of trait anger on emotional eating in a controlled, experimental design. This permits more precise measurement of both trait anger levels and actual caloric intake. Most prior studies have focused primarily on participant survey administration without any controlled manipulation of mood. The current study relied on survey administration but also a manipulation of conditions, and an appropriate set of controls for both the type of mood and sequence of conditions. Hence, the results obtained here define the impact of trait and state anger in a more quantitative manner, allowing for more precise measurement of eating behavior than many other investigators employed, contributing to our understanding of the relative impact of trait anger and a more precise stratification of risk factors.

**Implications of Results**

The results of the present study add to the existing literature on anger and emotional eating. They suggest a potential role for trait anger in emotional eating, which when considered in combination with state anger and gender, was found to explain up to one-third of the overall variance in emotional eating. This finding
implies that trait anger may be an important risk factor for emotional eating behavior. Gender effects held in both the anger and neutral mood conditions, and their role in emotional eating are not clear from the study results.

Anger can be considered a more harmful emotion than other negative affects due to the greater tendency toward harming self and others (Goleman, 2004). An aspect of this harm can be pathologic eating behavior, rumination, false attributions, and other harmful thoughts (Howells, 2004). Treating anger is important to help prevent development of unhealthy response behaviors, such as emotional eating (Wright, Day, & Howells, 2009).

It is interesting that magnitude of state anger by itself did not correlate with caloric intake. The underlying psychological characteristics or traits of an individual seem to matter more than the severity of the triggering event and resultant state. Low levels of trait anger predicted lower levels of emotional eating; higher levels predicted higher emotional eating. Because emotional eating may contribute to serious health consequences, including obesity, eating disorders and medical problems such as diabetes and hypertension, having a greater understanding of its risk factors and antecedent causes or triggers may be useful for the prevention of these disorders. The findings of this study suggest that higher levels of trait anger may be a risk for emotional eating and potentially resultant obesity, and should be evaluated in both screening and treatment paradigms.

Other factors evaluated in the current study did not correlate with eating behavior following anger induction. The results suggested that gender played a role
in determining eating behavior; however, this was independent of type of affect induced. The caloric intake results failed to demonstrate a correlation with other personal and demographic factors such as BMI category, income, size of household, level of education, marital status and ethnicity. This implies that high trait anger levels can affect many different ethnic, economic and socio-cultural groups.

Furthermore, based on the results described, both obese and lean individuals appear to be at risk for the potential impact of trait anger and emotional eating.

**Limitations of the Study**

The primary limitation of this study is the small sample size, which affects power and also limits the reliability of the findings, making them less applicable to other populations. The limited power of the analyses of demographic variables leaves open some critical questions about their potential importance in emotional eating, which can only be resolved in studies of larger samples. The sample had unequal distribution of some sub-groups, such as males (16 participants) compared to females (45 participants), limiting the power of the study to more definitively evaluate gender differences. Statistical testing was conducted to confirm that distribution of gender in high and low trait and state anger cohorts was not confounding results. However, gender might be more clearly associated with anger in a larger sample, as observed by other investigators. A larger sample of diverse participants is also critical to make more definitive and broadly applicable distinctions between trait and state anger and demographic variables related to eating behavior. In relation to BMI, the original study compared obese and lean
individuals. Hence, individuals with BMI scores between 25 and 30 were excluded. A larger sample could examine participants in this moderate BMI range of 25 to 30 in the future in order to generalize across the BMI spectrum.

The laboratory-based experimental design of the study is inherently not a naturalistic evaluation, and may not truly duplicate the real world experience of emotions or emotional eating behavior. While an experimental mode of evaluation does allow for the manipulation of experimental parameters, demand characteristics, and test conditions, it does not mirror actual life experiences. Hence, a limitation of the study is that the experimental design itself could be contributing to the observed results. Despite these limitations, in this experiment, there was an attempt to control for the impact of the induction procedure by also evaluating a neutral mood induction. This helps to assure that the induction design itself was not responsible for the findings. While this may help limit confounding, it is still an experimental rather than real life setting. In order to further mitigate the impact of the experimental design, the order of conditions (anger induction first, then neutral induction or neutral induction first, then anger induction) was controlled in the experimental procedure by counterbalancing the induction sequence. Based on these results, neither the neutral mood induction nor the order of conditions reached statistical significance as a relevant factor in caloric intake. However, despite these efforts to control for the impact of the design, it is still not possible to be certain whether the lab environment was contributing to the results, or distorting their applicability to real life settings.
Beyond the issue of experimental design, it is not clear if the experimental anger induction procedure, even if studied with the greatest rigor and in large samples, really can simulate anger as participants may experience it in real life. Furthermore, the ability of questionnaire-based measures such as the STAS and POMS to accurately detect and describe trait and state anger may also not be precise, particularly in an experimental setting. The reliability and validity of these measures may not be precise enough to discern less robust findings, particularly in a small sample. In addition, eating behavior in an experimental lab setting may not duplicate eating behavior at home or in other more naturalistic private or public settings, such as restaurants or social functions.

A Hawthorne effect, whereby participants being observed behave differently than they otherwise would without observation, is a potential confounder with the experimental design employed here (Adair, 1984). The location of the study in a laboratory setting of a medical school, with participants’ awareness of investigators measuring their behaviors, could have had an impact on the results. The same participants’ emotional eating behaviors may be more or less robust when eating in other settings, with family, friends or alone, when not being observed.

In the experimental design participants described past anger episodes which were then used to induce anger based on memory of the previous episodes. While recall-based inductions may achieve statistical reliability, it is not clear that these recalled episodes duplicate the real life experience of anger. Real life anger may not be experienced in the same fashion, with the same magnitude or with the same
impact on eating. It is also possible that differences in state anger are more a reflection of variations in participant recall capability and in susceptibility to imagination than in true differences in level of state anger.

In terms of food intake, participants in the study were to select foods to consume immediately following mood induction from choices provided. However, this process may not duplicate real life behavior where access to high carbohydrate and high fat food is not always immediately available following an episode of anger. Furthermore, the food choices provided may not account for all of the culturally diverse food offerings that participants may actually have or prefer in natural settings.

In terms of the statistical analyses, the small data set limits reliability of the results. The data in the final model were assessed using regression diagnostics to evaluate assumptions. Outlier points and points of high leverage were ultimately removed from the final model. While this manipulation does allow for normal distributions and other regression assumptions to be established, it also further limited the size of the overall data set and strained the reliability of the results. Significant findings were derived following removal of these outliers and high leverage points; however, it is with an offsetting tradeoff on reliability of the results based on further reducing sample size.

**Directions for Future Research**

The impact of trait and state anger on post-mood induction caloric intake should be studied in a larger sample, which would provide greater power to examine
these associations. In particular, a larger sample with more male participants should be considered in future studies in order to fully test gender-related questions. Larger samples of participants could also improve the assessment of other demographic characteristics, such as adding a mid range BMI group (BMI between 25 and 30). Larger samples might also allow for normal distributions of data points without need for removal of outliers or high leverage points.

In addition to STAS and POMS measures, future studies should employ other confirmatory measures of anger, including direct observation, physiologic parameters (such as heart rate and blood pressure), and other types of mood scales to validate the emotions that are being studied. Also, repeat studies on the same participants at three, six and 12 months, using the same design and measurement scales, might help confirm the consistency and reliability of the study, particularly as it relates to trait mood measures, outcome of mood induction (using varied induction scenarios) and caloric intake (using varied food types).

Future study should also examine the type of food consumed (e.g., high and low fat foods compared to high and low carbohydrate foods) to see if there are relationships between type of food consumed and emotional eating. In this study, total calories consumed were used as the dependent variable; however, calories from fat or carbohydrate were not independently analyzed as variables. It is possible that important distinctions could be made at this level of detail.

Some of the prior research in this area has looked at the physiologic state of hunger and resulting behavior (Nederkoorn, Guerrieri, Havermans, Roefs & Jansen,
Hunger scores were collected but were not analyzed in this study; they could be an area of future interest. Hunger may or may not correlate with emotional eating, and the experience of hunger may differ in participants who have differing trait and state anger characteristics. It would be interesting to examine whether emotional eating, as demonstrated in the present paradigm following experimental mood induction, occurs independent of hunger or in some way is related to level of hunger.

Another area for future research would be a naturalistic or observational study, where participants are evaluated in natural environments for anger characteristics (both trait and state), and measures are collected relating to observed real eating behavior experiences. For example, participants could be assessed based on actual behavior in their homes, restaurants or cafeterias. Of course, these environments are less suitable for carefully refined evaluation of emotional characteristics and manipulation of variables, but may provide better naturalistic eating behavior data. Online data collection could be employed to capture longitudinal self-report measures of mood and caloric intake for participants evaluated at home.

It is also important to look at the potential medical consequences of emotional eating related to anger. Such a study could evaluate the relationship of trait anger with the development of eating disorders and medical diseases, such as hypertension and diabetes. This type of analysis could be done by evaluating patients with eating disorders for high levels of trait anger, and comparing them with
demographically and health status matched groups of controls who do not have eating disorders. Higher levels of trait anger, and associated emotional eating, might be observed in the patients with eating disorders, particularly binge eating disorder (BED). A similar design could be employed to study trait anger in patients with hypertension or diabetes, compared to appropriately matched controls. The potentially confounding effect of gender should also be considered, particularly when designing the sample population.

In terms of interventions, trials of preventative insight oriented psychotherapy focused on anger and anger management might be important as a therapeutic intervention. Behavioral and cognitive therapy could also target anger episodes, in an attempt to inspire more emotional insight and alternative coping styles that avoid potentially harmful anger related emotional eating. The present study suggests that magnitude of trait anger is a predictor of emotional eating. Hence, a participant’s ability to have insight into their trait anger characteristics, and to develop appropriate coping styles before emotional eating develops, could be a way to limit potentially harmful impact. In this way, dialectical behavioral therapy might help patients identify strategies to regulate emotions such as anger, and provide alternate thought and behavior patterns that do not lead to emotional eating (Safer, Lively, Telch, & Agras, 2002).

Conclusion

The epidemic of obesity continues to affect the health and welfare of a growing majority of Americans. Nearly 30% of Americans are now considered
obese, with nearly half of all Americans predicted to become obese by 2030 (Centers for Disease Control, 2011). The factors that may be contributing to this epidemic of obesity are essential to understand so that appropriate screening and prevention programs can be implemented. Emotional eating may be an important contributing factor. The importance of negative affects, such as anger, cannot be overlooked as potentially vital clues as a cause of emotional eating. Similarly, gender based risk factors need to be considered as part of any epidemiologic approach or intervention.

The relationship between trait anger and emotional eating deserves further study to better define the impact and the best preventative and treatment paradigms to limit resulting morbidity. Furthermore, the elucidation of other factors such as gender, in combination with emotional states, may allow for the definition of particular high-risk groups for emotional eating that might help to identify individuals at risk and promote early intervention. Studies and interventions such as these could play important roles in future preventative initiatives that will be vital in diminishing the global impact of obesity and disordered eating.
REFERENCES


negative self-awareness, depression, and avoidance coping in undergraduates.

*Journal of College Student Development, 44*, 644-652.


experimentally induced changes in food intake under stress. *Appetite, 52,* 355-362.


Anger and Emotional Eating


Appendix A    State Trait Anger Scale: Trait Measures Questionnaire

STAS (Trait Measures)

Directions: A number of statements which people have used to describe themselves are given below. Read each statement and then place a check mark in the appropriate box to the right of the statement to indicate how you generally feel.

1 = Not at all
2 = Somewhat
3 = Moderately
4 = Very much

1. ______ I have a fiery temper
2. ______ I am quick tempered.
3. ______ I am a hot-headed person.
4. ______ I get annoyed when I am singled out for correction.
5. ______ It makes me furious when I am criticized in front of others.
6. ______ I get angry when I’m slowed down by others mistakes.
7. ______ I feel infuriated when I do a good job & get poor evaluation.
8. ______ I fly off the handle.
9. ______ I feel annoyed when I am not given recognition for doing good work.
10. _____ People who think they are always right irritate me.
11. _____ When I get mad, I say nasty things.
12. _____ I feel irritated.
13. _____ I feel angry.
14. _____ When I get frustrated, I feel like hitting someone.
15. _____ It makes my blood boil when I am pressured.
Appendix B  
**POMS: Profile of Mood States Questionnaire**

ID #:___________  Date:___________  Visit:__________  
Time:________

BELOW IS A LIST OF WORDS THAT DESCRIBE FEELINGS THAT PEOPLE HAVE. PLEASE READ EACH ONE CAREFULLY. THEN CIRCLE THE NUMBER TO THE RIGHT THAT BEST DESCRIBES HOW YOU ARE FEELING RIGHT NOW.

The numbers refer to these phrases:

1. Not at all  
2. A little  
3. Moderately  
4. Quite a bit  
5. Extremely

<table>
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<tr>
<th>1. Friendly</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>34. Nervous</th>
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<td>2. Tense</td>
<td>0</td>
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<td>35. Lonely</td>
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<td>3. Angry</td>
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<td>3</td>
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<td>36. Miserable</td>
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<td>4. Worn out</td>
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<td>1</td>
<td>2</td>
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<td>37. Muddled</td>
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<td>5. Unhappy</td>
<td>0</td>
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<td>4</td>
<td>38. Cheerful</td>
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<td>6. Clear-headed</td>
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<td>39. Bitter</td>
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<td>7. Lively</td>
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<td>40. Exhausted</td>
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<td>8. Confused</td>
<td>0</td>
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<td>41. Anxious</td>
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<td>9. Sorry for things done</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>42. Ready to fight</td>
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<td>10. Shaky</td>
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<td>43. Good natured</td>
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<td>11. Listless</td>
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<td>44. Gloomy</td>
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<td>12. Peeved</td>
<td>0</td>
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<td>45. Desperate</td>
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<td>46. Sluggish</td>
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<td>Appendix B (Continued)</td>
<td>POMS: Profile of Mood States Questionnaire</td>
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<td>13. Considerate 0 1 2 3 4</td>
<td>2 3 4 47. Rebellious 0 1</td>
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<td>14. Sad 0 1 2 3 4</td>
<td>2 3 4 48. Helpless 0 1</td>
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<td>15. Active 0 1 2 3 4</td>
<td>2 3 4 49. Weary 0 1</td>
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<td>16. On edge 0 1 2 3 4</td>
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<td>17. Grouchy 0 1 2 3 4</td>
<td>2 3 4 51. Alert 0 1</td>
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<td>18. Blue 0 1 2 3 4</td>
<td>2 3 4 52. Deceived 0 1</td>
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<td>19. Energetic 0 1 2 3 4</td>
<td>2 3 4 53. Furious 0 1</td>
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<td>20. Panicky 0 1 2 3 4</td>
<td>2 3 4 54. Efficient 0 1</td>
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<td>21. Hopeless 0 1 2 3 4</td>
<td>2 3 4 55. Trusting 0 1</td>
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<td>22. Relaxed 0 1 2 3 4</td>
<td>2 3 4 56. Full of pep 0 1</td>
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<td>23. Unworthy 0 1 2 3 4</td>
<td>2 3 4 57. Bad-tempered 0 1</td>
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<td>24. Spiteful 0 1 2 3 4</td>
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<td>25. Sympathetic 0 1 2 3 4</td>
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<td>26. Uneasy 0 1 2 3 4</td>
<td>2 3 4 60. Carefree 0 1</td>
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<td>27. Restless 0 1 2 3 4</td>
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<td>28. Unable to concentrate 0 1 2 3 4</td>
<td>2 3 4 62. Guilty 0 1</td>
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<td>29. Fatigued 0 1 2 3 4</td>
<td>2 3 4 63. Vigorous 0 1</td>
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<td>30. Helpful 0 1 2 3 4</td>
<td>2 3 4 64. Uncertain about things 0 1</td>
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<td>31. Annoyed 0 1 2 3 4</td>
<td>2 3 4 65. Bushed 0 1</td>
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<td>32. Discouraged 0 1 2 3 4</td>
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<td>33. Resentful 0 1 2 3 4</td>
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Appendix C  Participant Recruitment Advertisement

Research Participants Wanted

Are you between the ages of 18 and 65?

Do you speak English?

If so, you may be eligible to participate in research about the effects of memories on eating at the University of Massachusetts Medical School.

If eligible, you will complete a 3-hour interview session and three 1.5-hour experimental sessions.

Compensation will be provided.

For more information, please call

-----

Do you enjoy snacking?

If you are between the ages of 18 and 65 and enjoy snacking, you may be eligible to participate in a research study at UMass Medical School in Worcester.

Your participation will include 4 study visits: one screening session and three experimental sessions. All participants will receive compensation.

Find out if you qualify for the snacking study by calling